The Glass Industry
REG. U. S. PAT. OFF.

Vol. 12 DECEMBER, 1931 No. 12

Some Recent Developments in American Glass Manufacture

By ALEXANDER SILVERMAN
Head of the Department of Chemistry, University of Pittsburgh

THE outline of recent developments in glassmaking here presented was given in French at the Tenth Congress of Industrial Chemistry, Liege, Belgium, by Alexander Silverman, Head of the Department of Chemistry, University of Pittsburgh, as Delegate from the American Ceramic Society. It is a translation of the original article which appeared in French in the Journal of the Society of Industrial Chemistry of France, Vol. 25, Part 2, pages 567-578, 1931, and appears here by way of record. It does not purport to describe matters unfamiliar to our American readers, for many of the subjects have already been covered in more detail in these pages. It does, however, give a synopsis of the state of the art.

Curiously enough, Prof. Silverman, who is engaged primarily in academic work, reviews the matter essentially from an industrialist's standpoint. In our last issue we printed an important review by Dr. Sullivan, Vice Chairman of the Board of Corning Glass Works, on recent developments of our knowledge of glass and Dr. Sullivan, who is primarily an industrialist, spoke essentially from the point of view of pure science.—*F. W. P.*

RECENT developments in glass manufacture in the United States of America cover a variety that would include the development of special chemical and physical properties of the product and the chemical and physical control during its production. Pure researches are under way in the government bureaus and in the laboratories of industrial research institutions and universities. Attention has been paid not only to the control of composition of raw materials but also to the development of the state of aggregation of these materials that facilitates handling and use and eliminates difficulties formerly encountered in a material that was either too fine or too coarse. The standardization of methods of analysis prompted by the American Ceramic Society and developed in the United States Government laboratories with the cooperation of industrial laboratories has already progressed favorably. The standardization and classification of such raw materials as lime and limestone, feldspar, etc., has been the result of joint effort of the American Ceramic Society and other scientific societies, the United States Government, producers and consumers. Of chemicals that have been added to batches

FIG. 1a. CASTING AND ROLLING PLATE GLASS (BICHEROUX PROCESS) Preparatory to electrical annealing

in the glass industry as a whole, to supplement the former simpler batches, perhaps feldspar and borax head the list. Selenium has, of course, almost entirely replaced manganese dioxide as a decolorizer. The manufacture of titanium oxide is under way for the promise that this material seems to hold in glass and enamel manufacture. Among the newer glasses that have been developed from a pure research standpoint are those principally of germanium and beryllium. These have as yet had no industrial application.

The glasses of low expansion have found their use in the laboratory and household, while those of special light-transmitting properties, such as the passing of ultraviolet with or without the ordinarily visible rays, have found considerable agricultural, industrial and domestic application. A few new colors have been developed. The more important of these in the field of yellow, lilac and red glasses remain industrial secrets. In the field of illuminating glassware, the production of pale blue crystal to approximate daylight by correcting for the yellow rays transmitted by the lamp filament and the use of the newer zinc-aluminum borosilicate opals for high transmission with a thorough obscuring of the lamp filament are the outstanding developments. Recently a rather novel opal crystal effect has been produced by reheating portions of ware made from phosphate glasses that are crystal when taken from the pot and flash on reheating. It will be recalled that these glasses were discarded years ago when the aluminum-fluorine opal glasses came into being.

While some references will be made to treatment in this article, it will confine itself largely to a discussion of mechanical developments for after all the greatest progress in the United States has been in the field of applied physics or engineering to glass manufacture.

Window and Plate Glass Manufacture

In the manufacture of window glass, the old Lubber's process for the drawing of cylinders has gradually given way to continuous sheet drawing processes. These include the Fourcault or Belgian method and the Colburn or American method. While the processes themselves are familiar to technologists it might be interesting to note that numerous announcements are made from month to month concerning improvements in mechanical devices for the operation or perfection of these two fundamental processes.

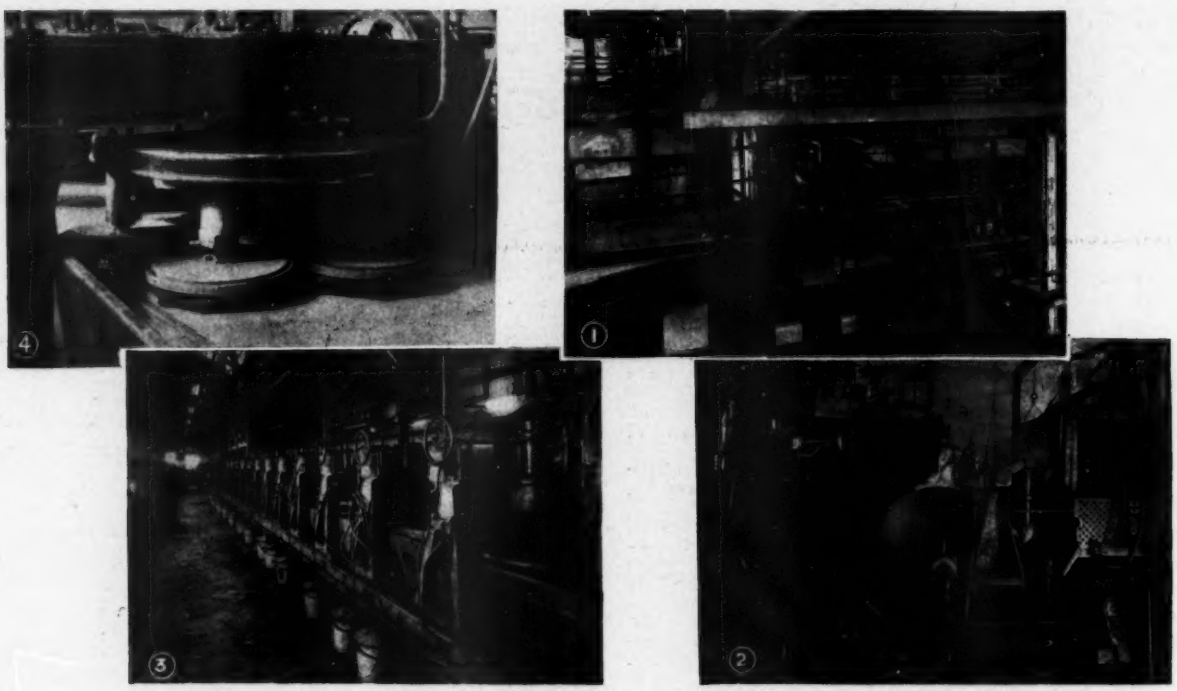


FIG. 1. FEEDING GLASS TO ROLLS IN FORD MOTOR CO. CONTINUOUS PLATE GLASS PROCESS. FIG. 2. FEEDING GLASS TO ROLLS. CLOSE UP FORD MOTOR CO. PLATE GLASS PLANT. FIG. 3. GRINDING MACHINES FORD MOTOR CO. PLATE GLASS WORKS. CONTINUOUS PLATE PROCESS. FIG. 4. POLISHING PLATE GLASS FORD MOTOR CO. CONTINUOUS PROCESS.

With the advent of the continuous plate glass process and

FIG. 5. PLATE GLASS ENTERING ELECTRIC LEHR

the manufacture of laminated glass, the window glass industry is gradually losing its independence and is getting into the production of some plate glass. Modifications of the Fourcault and Colburn processes as well as the continuous plate glass processes are giving us heavier sheets than were formerly produced in the cylinder machines. These are subjected to a continuous grinding and polishing process so that sheet glass can be employed for the production of laminated ware through the introduction of plastics.

FIG. 6. PLATE GLASS EMERGING FROM ELECTRIC LEHR

Plate glass companies are in turn introducing machines for the manufacture of window glass by the continuous sheet process and are so modifying their plate glass processes as to yield thinner and thinner plates to serve for the production of light weight laminated panes. Casting from pots is still in practice but the continuous process is meeting with greater and greater favor. As a result of the interest of window glass manufacturers in plate glass and in turn plate glass manufacturers in window glass, one finds a growing tendency towards consolidation between plate glass and window glass interests.

The writer understands that one company is now utilizing an electrically heated rapid melting furnace which is about 40 x 40 cm. inside by 150 cm. long. While some difficulty is being experienced with the refractories the process looks promising for the rapid production of glass for plate manufacture. The outstanding example of continuous melting and rolling of plate glass is, of course, the Henry Ford plate glass company's plant at Detroit, Michigan. (See Figures 1 to 4.) This has met with unusual success. The Bicheroux process is gaining favor in many plate glass plants. While discussing the plate glass industry, it might be proper to mention the pots patented recently for the Pittsburgh Plate Glass Company by Mr. Showers, under United States patent No. 1,754,838. These pots are cast in two layers, the inner layer consisting of finer material than the outer one. This procedure is said to insure longer pot life and minimize corrosion and stone formation. The coarse material provides a supporting body which stands the strain imposed by handling of pots and the finely divided material does not crack in firing.

While many improvements have been made in the annealing of plate and window glass, it will be of particular interest to note that at the General Motors Company's National Plate Glass Company's[1] plant at Ottawa, Illinois, an electric lehr has been installed for annealing the ware. As patents were recently granted for this device in Belgium, it may be of further interest to provide some details. Fig. 1a shows the glass emerging from the pot and beginning to pass between two rolls located in front of the pot. The plate then travels on an inclined conveyor and enters the hot end of the lehr shown in Fig. 5. Fig. 6 shows the plate that has emerged from the lehr. The writer understands that this is the only electrically heated lehr that is in successful use in the plate glass industry today. It is claimed that the time required for good annealing is 30% less than formerly required in gas-fired lehrs. Glass leaves the rolls at slightly above 800° C. The entrance of the lehr is about 15 m. from the rolls, the glass entering at about 650° C. A pot is cast every seven minutes. This provides time to clean the rolls and hopper for the next pot. The length of the sheet varies according to the thickness. Sheets usually run 3.7 m. wide and 12 to 35 m. long. The machines will roll glass as thin as 3 mm. Glass cast by the old process for a 6 mm. plate had to be 11 mm. thick. The thinner glass is possible because of the straighter sheet produced by the new lehr. The difference in thickness effects a saving in glass and grinding time, for the new plates must be ground away only 2.24 mm., while the old ones required 5.25 mm. The lehr proper is 225 m. long and 5 m. wide and is all steel construction. Instead of passing directly through the lehr the glass travels forwards and backwards to economize

[1] [Now merged with The Libbey-Owens-Ford Glass Company.—Ed.]

on lehr length, going forward 1½ m. and backward 1 m. in each cycle, thus moving forward ½ m. per cycle. The control is automatic. The glass remains at 650° C. in the first 37 m. of the lehr and shortly thereafter the temperature begins to drop. Annealing is complete in one hour while the old process required three and one-half hours. The temperature can be controlled within about 1° C. Thermocouples and temperature-recording instruments are located at twelve points in the hot end of the lehr. This information has been obtained through the courtesy of the Simplex Engineering Company of Washington, Pa. Formerly most of the plate glass produced in America was 6 mm. Today the major portion is 3 mm. thick.

FIG. 8. EXAMINING PLASTIC BOND BY TRANSMITTED LIGHT, FOR IMPERFECTIONS. FIG. 10. TESTING PLASTIC SHEET FOR UNIFORM THICKNESS

Mention of the laminated glass industry has been made already. This is responsible for the manufacture of the thinner plate glass. Some research has been completed and some is still under way on the development of the plastic bond for the laminated glass. Pyroxalin, condensation products, gelatin, and numerous other materials are employed in manufacture and experimentation. Tests are conducted with ultraviolet light to guard against the use of materials that will discolor in sunlight. The formation of blisters and spots is the subject of extensive investigation. In one recent patent a rubber pad is applied under pressure and heat to imperfect plates at points where spots appear. With this treatment permanent adhesion is insured and the spots are eliminated. It is thus possible through supplementary treatment to perfect a plate which would otherwise have to be discarded or sold as imperfect. Figs. 8, 9, and 10 show the examination of the bonding mass in the Libbey-Owens-Ford Plate Glass factory. Another development is the use of a recessed bond. The interstices around the edges of the plate are then filled in with an inert material which prevents the weathering of the bond through atmospheric agencies.

New developments in mirror manufacture must not be overlooked in discussing plate glass. A comparatively recent patent covers the spraying of a colored plastic onto a plate of glass and the subsequent silvering of the plastic side by the wet process. The mirror is then backed in the usual way. A variety of ornamental and artistic effects is possible with the application of this process. A second principle covers the use of plate glass that is silvered in ornamental patterns and then converted into a two-layer laminated glass where the plastic is colored or possesses a mother-of-pearl effect. Very artistic designs have already been produced for the manufacture of art plateaus. These are now in production in the factory of the Duplate Corporation. The possibilities of applying art in the two processes just cited would seem to be unlimited.

Speaking of mirrors one should not overlook the conference that was held recently by the Mirror Manufacturers Association with the Division of Trade Standards of the United States Bureau of Standards. Leading mirror manufacturers of America were represented and it was proposed that they stamp their ware with colored labels indicating qualities AA, A, 1, 2, and 3, respectively. The first of these is the highest quality and the grades recede in the order given. These grades come under commercial standard specifications CS27-30 for mirrors issued by the United States Department of Commerce.

There has been an extensive development in the manufacture of black and colored plate glass for decorative purposes in building construction. The black plate is used either plain or sand blasted and etched. In some factories the glass is cast in plates of two colors and the pattern is etched through the one color. Highly ornamental effects are produced in this manner. Glass of this type is applied for the facing of store fronts and interiors, the lobbies of hotels and public buildings and for the lining of bathrooms and swimming pools.

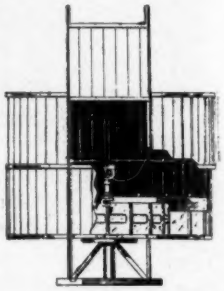


FIG. 9. UNIT FOR TESTING BONDING MASS UNDER ULTRAVIOLET LIGHT

A number of projects are underway for the construction of entire buildings of glass, steel and concrete. In these, glass will be used not only for lighting units but also in the construction of the building proper.

Electric Light Bulbs

Perhaps the most startling development in the application of new principles in mechanical manufacture is the new bulb machine of the Corning Glass Works covered by British patent No. 276,606 of 1927. The principle is illustrated in the drawing shown in Fig. 11, where glass (78) flows continuously between rolls in a downward direction, taking a horizontal position on a continuous table. The ribbon of glass has lens-like elevations and these pass successively under a series of blowheads forming larger and larger bubbles (150-271-269), finally entering a mold (280) where the bulb is blown. Fig. 12 is a continuation of this drawing and it will be observed that the flanges produced by the blowheads are removed by a rotating wheel (352). The machine is in successful operation at the Wellsboro and Rhode Island plants of the Corning Glass Works. With the

necessary modifications it is possible that these machines may be developed for the manufacture of other hollow ware and supplant a great variety of machines that are in operation at present.

Another item of interest in connection with electric lamp bulb manufacture is the development of the Danner process for the drawing of tubing and rods. The company mentioned in the preceding paragraph has just completed a large factory at Fall Brook for the commercial utilization of this process on a large scale.

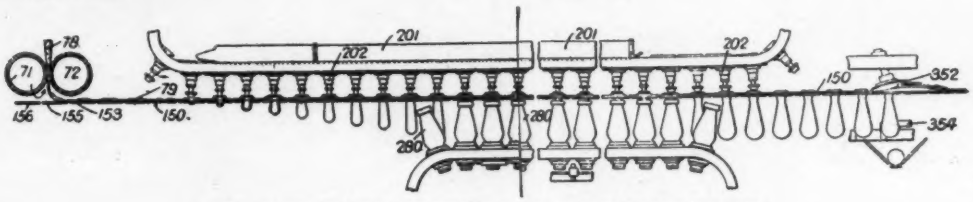


FIG. 11. NEW BULB MACHINE OF CORNING GLASS WORKS

Electrical annealing of lamp bulbs has been developed. The General Electric Company has constructed a conveyor-type lehr 4.3 m. long, about 1 m. wide and 60 cm. high, which operates at 540° C. It is a 60 kw-220 v.-3 phase 60 cycle system. This is shown in Fig. 13. Another electric lehr, Fig. 14, has been developed for annealing vacuum tubes and X-ray bulbs. It is 8.3 m. long, 1.5 m. wide and 60 cm. high. This is a 120 kw.-220 v.-3 phase system.

Nor must we overlook the inside frosting process developed several years ago. The idea originally met with many obstacles. It was found, for example, that when bulbs were given a single acid treatment on the interior they were fragile and collapsed under the vacuum. Subsequent studies in which the original acid treatment was followed with a second employing spent or old acid left over from previous frostings met with success. Then the question arose, "How can the operator determine the extent of the vacuum formerly observed by the color of the glow of gases in the lamp when the entire interior is frosted?" This problem solved itself, for when the neck of the bulb was heated for drawing out and sealing in the tubes and filament support, the frosted portion became clear and it was possible to observe the glow through the clear portion of the lamp.

Lamp bulbs of special glass composition have been developed recently for the transmission of light of short wave lengths and the composition so regulated that ultraviolet light baths can be taken in the home with perfect safety. The lamps are provided with tungsten rods and contain mercury. They have to a considerable extent supplanted the older arc and mercury vapor lamps that were employed for this purpose.

Optical Glass

The United States now produces many of the ordinary types of optical glass as well as special types that have been developed largely through the Bureau of Standards. A noteworthy accomplishment of the Bureau that should be mentioned is that of Dr. A. N. Finn and his associates in the casting of a 135 cm. reflector for the Wesleyan University observatory. The glass was stirred with a capped iron pipe through which water is circulated. Glass solidifying on the cold iron protected the pot contents from contamination. This is a decided improvement over the old porcelain stirrer. The pot was so placed in the furnace that it could be tilted and the glass poured into a brick-lined depression in the floor. The casting was then covered with an insulated top provided with electrical measuring instruments and was annealed in the brick mold. It was then removed as is evident from Fig. 15 which shows the grinding and polishing of the surface. In Fig. 16 we see the reflector being drilled for mounting.

As in other branches of the glass industry the use of electricity for annealing is entering the optical glass field. Not only is it employed for the annealing of the larger lenses and reflectors as heretofore, but also for smaller lenses and prisms. Fig. 17 shows one of these furnaces which is 60 cm. x 135 cm. and heated to 600° C. The operating system is 39 kw.-220 v.-3 phase.

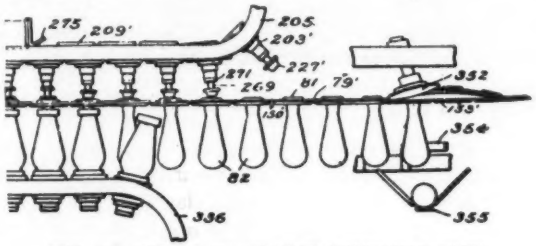


FIG. 12 DETAIL OF FLANGE REMOVING DISK

The cheaper lenses are now manufactured from plate glass which is cut into small pieces and either ground to lens formation or reheated and pressed in a mold before grinding and polishing. Still cheaper lenses are pressed directly from the molten glass or rods and frequently sold without subsequent grinding and polishing.

The Bottle Industry

Here it would seem that the most important recent development is the introduction of the multiple mold which permits of the manufacture of eight bottles per second. Improvements are being made constantly on both the vacuum and feeder types of machines and a great variety is in use. One recent improvement in some of these machines is the introduction of a revolving plunger. This results in a better distribution of the glass. Machines are now so constructed that a variety of molds can be used in a single machine, thus permitting the smaller manufacturer to make bottles of various sizes instead of confining himself to producing a single size on a given machine. Feeding and blowing parts of some machines seem to be capable of considerable regulation as is evident from the variety of art designs applied to bottles, especially of the perfume type. These are now produced in many shapes and sizes.

As in other branches of the industry, electricity is being

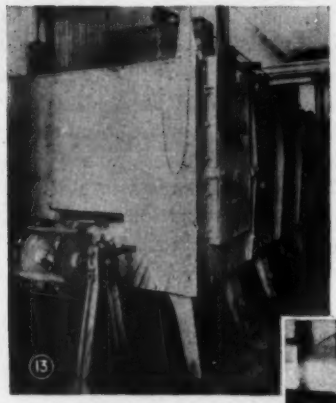
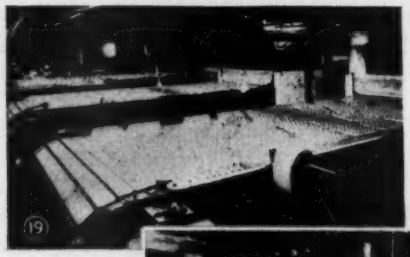


Fig. 13. Conveyor Type Electric Lehr for Lamp Bulbs—4.3 m. x 1 m. x 60 cm. high, 540 c. 30 kw.—220 V-3 phase-60 cycle.



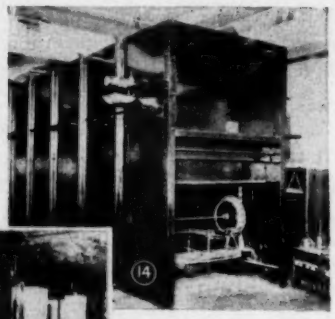


Fig. 14. Electric Lehr for Annealing Vacuum Tubes and X-Ray Tubes—8.3 m. x 1.5 m. x 60 cm.—120 kw.—220 V-3 phase.

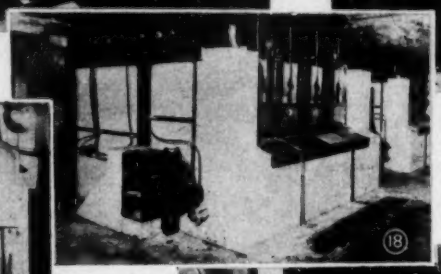
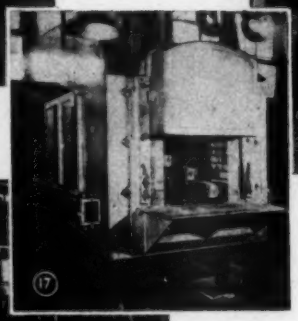


Fig. 18. Electric Bottle Lehrs—2.8 m. x 15 m. x 60 cm. high—240 kw. max. temp. 650° c.



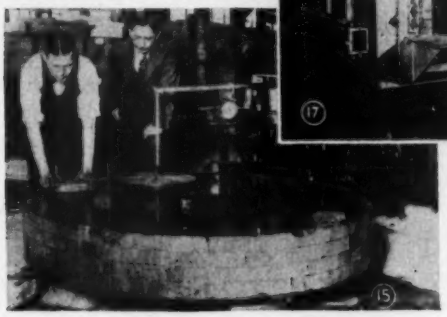


Fig. 15. Grinding 175 cm. Reflector for Wesleyan University—At U. S. Bureau of Standards.

Fig. 17. Electric Furnace for Annealing Lenses and Prisms—6-mm. x 135 mm. 600° c. 39 kw. —220 v.-3 phase.

Fig. 19. Exit-General Electric Bottle Lehr—2.8 m. x 15 m. x 60 cm. 240 kw. per hour—maximum temp. 650° c.

Fig. 16. Drilling 175 cm. Reflector for Wesleyan University—Cast at U. S. Bureau of Standards. Finished by J. W. Fecker.

utilized for the annealing of the ware. Several of the larger manufacturers of bottles employ electrically heated lehrs. Those installed in one of the largest plants are 2.8 m. wide, 15 m. long and 60 cm. high. The maximum temperature is 650° C. Each of these lehrs consumes 240 kw. per hour. Fig. 18 shows the entrance and Fig. 19 the exit of this type of lehr. The Amsler-Morton Company have made a novel contribution to gas fired lehrs. These are portable units and can be moved from place to place in the factory on wheels. In some factories they will possess a distinct advantage over the built-in lehrs.

Transparent Fused Quartz

While considerable has been written about the manufacture of transparent fused quartz, especially in rods, tubes and other massive forms, a word about plates or panes might be in order. At the works of the General Electric Company at West Lynn, Massachusetts, Brazilian quartz is selected carefully, defects are chipped off with a blow torch, and the material is melted in trays in water-insulated, vacuum-pressure furnaces. Fig. 20 illustrates the loading of the trays with quartz, and Fig. 21 the lowering of the stack of trays into the furnace. The product is still very expensive but for ultraviolet light transmission it has no manufactured competitor.

Refractories

The research departments of a number of large refractories manufacturers are engaged in investigations towards the lowering of corrosion, resistance to spalling, and especially resistance to corrosion. Thermal properties of the refractories are also receiving much attention. The two-layer pots for plate glass manufacture have already been mentioned. Among the refractories of high mullite content, the product of the Corhart Refractories Company is given especial mention. This is produced by melting selected diaspore, kaolins and bauxites in electric furnaces and pouring the resultant liquid into sand molds. The dense, hard product has a porosity of less than 1% and a hardness greater than glass. The softening point is 1785° C. Petrographic analysis indicates that the block contains approximately 40% corundum, 47% mullite and the balance an interstitial glass of high melting point. The finely divided state of the crystals and their uniform distribution makes the mass almost homogeneous. The results claimed are longer life and a better quality of glass. It is said that in the window glass industry this type of refractory will last five to ten years longer than the ordinary clay refractories. A 20 cm. wall of this block has been in operation for a full year without interruption, while ordinary clay refractories have required a number of hot repairs during this period. This material is said to eliminate block stones and its lower rate of corrosion minimizes cords. One further advantage lies in the elimination of stones in the manufacture of opal glass and a longer furnace life for this type; and an added advantage is the low ferric oxide content—less than .7%—and lower than the amount found in the ordinary refractories. Thus far the manufacture of this type of refractory has been limited to tank blocks but experiments are un-

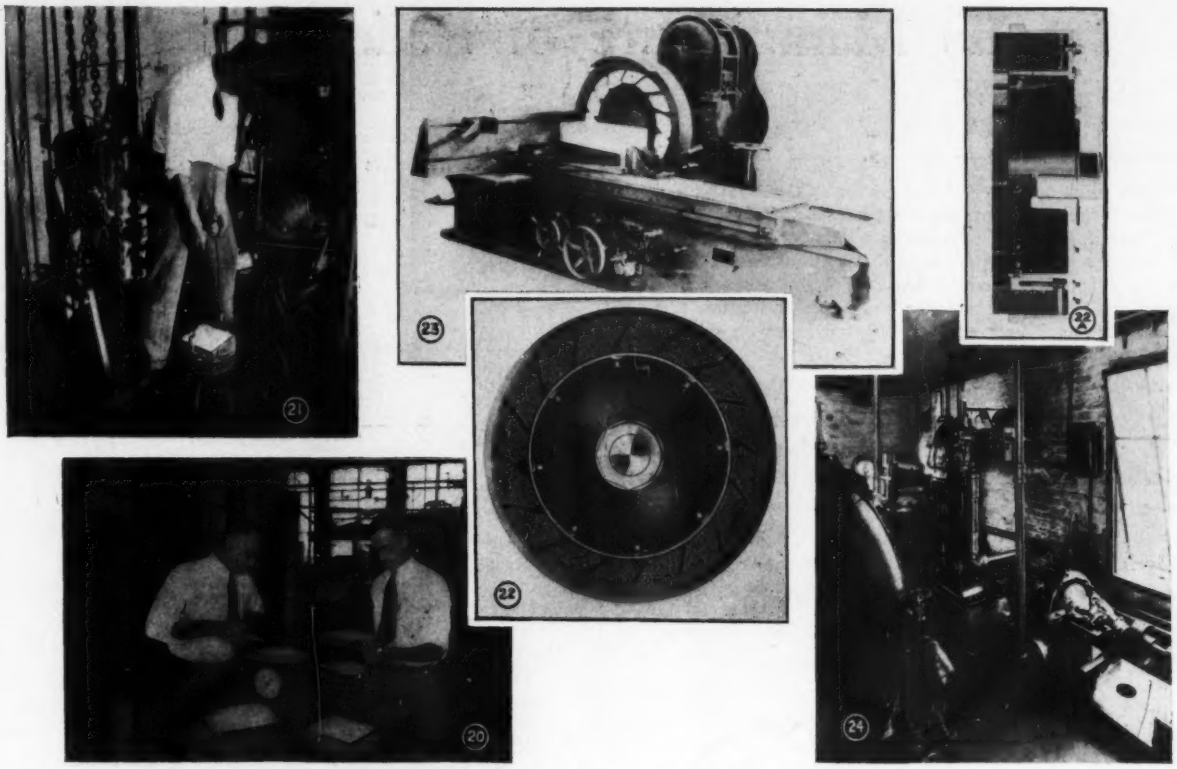


FIG. 20. LOADING TRAYS WITH CRYSTAL QUARTZ FOR TRANSPARENT FUSED QUARTZ WINDOW PANE MANUFACTURE. FIG. 21. LOADING FURNACE FOR MANUFACTURE OF TRANSPARENT FUSED QUARTZ PANES. FIG. 22 AND 22a. SAFETY GRINDING WHEEL FOR SIZING TANK BLOCKS. FIG. 23. EQUIPMENT FOR TRIMMING GLASS MELTING TANK BLOCKS. FIG. 24. CENTRIFUGAL PRESSURE CLEANER FOR FUEL OIL FOR GLASS FURNACE.

der way which promise production of pots. The use of recessed grinding units has come into practice in some refractory plants. At the Ohio Valley Clay Company's plant these wheels are employed for trimming down the finished tank blocks to exact size, thus insuring flat surfaces and perfect contacts. The claim is made that furnaces built of trimmed block have a better life and resistance to corrosion. Fig. 22 shows the recessed emery units in the wheel and Fig. 23 the trimming operation.

Fuels

Glass factories in a number of localities in the United States have abundant supplies of natural gas. Others employ producer gas or oil. In connection with the use of oil, pressure cleansers are now employed, one of which is illustrated in Fig. 24. Oil is coming more and more into use as a glass manufacturing fuel in America. The introduction of electricity for heating has already been mentioned in previous sections. Greater economies are also being effected by the installation of new regenerative and recuperative devices.

Summary and Conclusions

Scientific study along chemical lines for controlling composition and properties is making great strides.

The plate and window glass industries are utilizing the newer methods for continuous plate and sheet production and gradually introducing electric melting and annealing. The laminated glass industry is making rapid strides and is indicating a transition from the mere production of protective glass to the development of articles of artistic merit.

The electric bulb industry has been blessed with a new machine of original design and pattern merit. The manufacture of glasses of special composition and the interior etching process for bulbs are important steps forward.

In the bottle glass industry quantity production has reached a point never before attained. With it comes the advantage of flexibility of use of the machine for a variety of articles.

America has made a distinct contribution to the melting of optical glass for larger units in methods of stirring, casting and annealing. Large-scale production of inexpensive optical units is another development.

Transparent fused quartz with its precious optical properties is manufactured on a fairly large scale and the process seems to be under good control.

Refractories have been improved and methods for the prevention of corrosion by both composition and close-fitting construction have been devised.

Natural gas is available in many regions and the design of producer gas units has been improved from the standpoint of economy and cleanliness of the fuel. Oil is coming into extensive use and methods for cleansing and pressure spraying have been devised.

These are only a few of the recent developments in glass manufacture in the United States. The discussion is limited only by the elements of time and space for its presentation. Grateful acknowledgment is made to THE GLASS INDUSTRY, the *American Glass Review*, the *National Glass Budget* and many manufacturers who have made this presentation possible.

The Manufacture of Rolled Plate

By ERNST LUTZ *

(*Continued from the November, 1931, issue*)

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

FIGS. 151 and 152 show the approximate power required by the grinding and polishing apparatus with tables of 33 ft. diameter and 26 to 28 r.p.m. for the working of one table setting, i.e., one side of the sheets; the polishing machine in this case is fitted with a single runner.

Figs. 153 and 154 illustrate grinding apparatus of similar design, as used by the St. Gobain Company, for tables

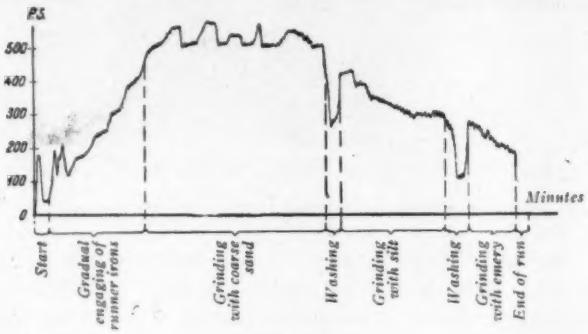


FIG. 151

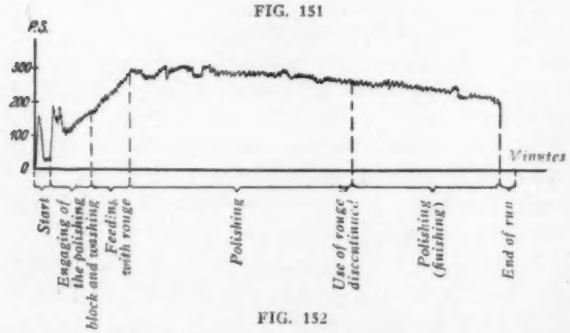


FIG. 152

of a diameter of 33 ft. The trusses for carrying and guiding the grinding discs are built up of cast iron tubes and boxes; they are of very rigid design and in contrast to trusses built up of wrought iron, hardly vibrate all, which of course is advantageous as regards the grinding. As mentioned before, the grinding discs are firmly connected with the hollow guiding shafts A, while the solid shaft A, which pierces the said hollow shafts serves for their suspension. The shaft B transmits the downward load of the grinding disc on to the bearing C, which is carried by the beam D. E indicates an oil catcher fitted at each hollow shaft, preventing oil from the top bearings from dropping on to the grinding table, thus reducing the grinding effect. Each of the hollow shafts also carries a basin F for the cleaning water; at the point where these basins are fixed to the shafts these latter are provided with one or a number of slits

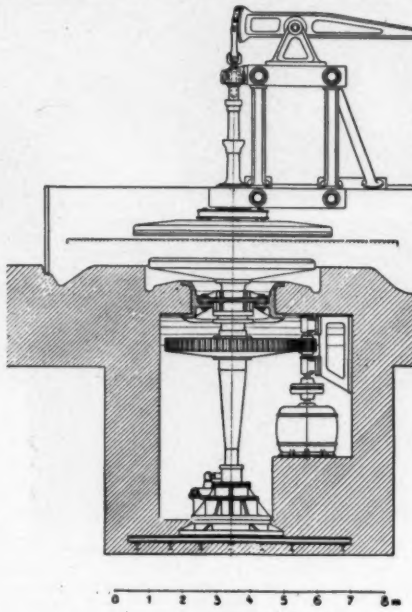


FIG. 153

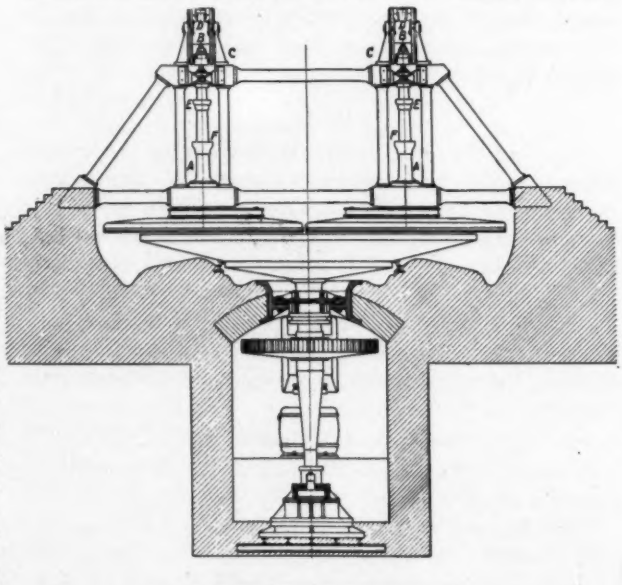


FIG. 154. POLISHING MACHINE, SYSTEM MALEVEZ
(*From the old Dralle*)

* Of Desseau, Germany. This work is appearing in German in the new edition of *Dralle-Keppeler*, "Die Glasfabrikation."

FOOTNOTE: In the Figures, originally prepared for use eventually in the new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches, and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre.—*F. W. P.*

through which the cleaning water can penetrate into the shaft and therefrom run on to the grinding table; this device enables the runner bars at the grinding disc-center to be washed and freed from sharp grains before fine grinding is started.

The king-shaft runs on a cast iron thrust plate; the foot plate turning with the shaft also consists of cast iron. The whole bearing within the closed casing runs in oil. The cover of the casing is designed as a guide bearing for the foot of the king-shaft. In order that the king-shaft, including the grinding table, may be lifted and lowered, the

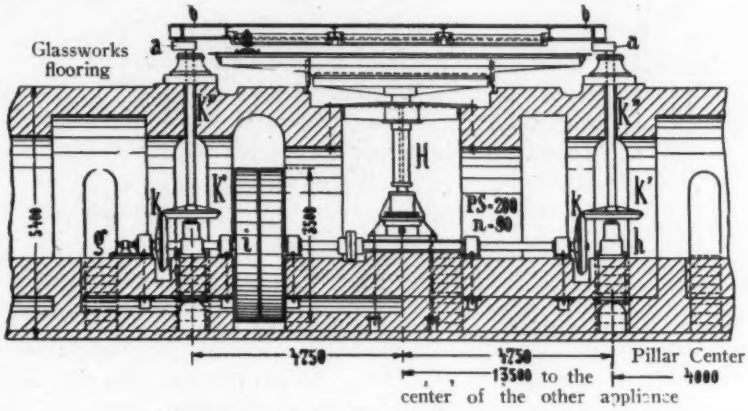


FIG. 155

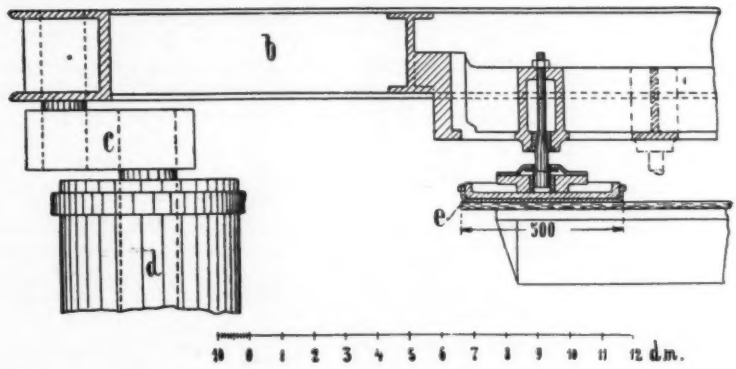


FIG. 156

said casing is made to act as an oil or glycerine pump, the compression cylinder of which is formed by an iron casting embracing the piston. In order to prevent the dropping of the king-shaft and the table during the work, a special plate provided beneath the casing is somewhat turned, so that a number of cams, which before were hidden in recesses, now support the plate and hold the shaft in its upper position.

The weight of a grinding table of 33 ft. diameter is about 45 tons. The table is built up of individual segments of cast iron turned true and planed; in fixing them on to the table frame they are carefully aligned and if required packers are inserted. Before the table is put into commission its surface is ground in a grinding apparatus with sharp sand and water.

POLISHING APPARATUS WITH CIRCULAR TABLES

On the basic principles underlying the design of polishing machines, Dr. F. W. Preston has written very valuable papers. (See "THE GLASS INDUSTRY," Vol. 9, No. 2, 3 and 4 of February, March and April, 1928.)

Figs. 155 to 157 show an earlier design of a polishing apparatus with a polishing frame b moved by 4 cranks e, for tables of about 28′ diameter. Suspended on the frame b are the polishing blocks e, faced with felt, and the cast-iron plates of which have a diameter of 20″. The number of the blocks and their distribution in the frame has to be so chosen, that all parts of the table surface obtain as nearly as possible a uniform polishing. The cranks a are rotated from the main transmission shaft over the solid pulley i and the four bevel wheel pairs k and k′, so that the polishing frame executes horizontal oscillations. The table is moved into this polishing apparatus in the same way as into the grinding apparatus. By the lifting of the king-shaft H it is then put on to the cone. The polishing blocks e, suspended at the frame b, have about 1″ vertical clearance; the king-shaft together with the table is lifted till the polishing blocks are no longer held by the frame but rest with their full weight on the table. During the polishing the suspension bolts of the blocks evidently serve only as guide and drive. The crank radius is about 9½″, so that each point of the frame and with it the suspension bolts and the polishing blocks travel during the movement of the frame in circles of about 19″ diameter. The cranks and the frame move with about 80-100 r.p.m.. The king-shaft is free to turn in the footstep bearing; as soon as the vibrating polishing felts come into close contact with the glass, the table starts to move also; together with the king-shaft it

turns at speeds up to 1½ r.p.m. The polishing blocks also turn round their guide pins.

As mentioned before, other polishing machines have been designed similar to grinding machines as illustrated in Figs. 136-138 (see also Figs. 158-159). In this case the king-shaft with its table is positively driven so that it turns with 12 to 18, or, on the average, with 14 r.p.m.; in place of the two grinding discs there are now two to four spiders, or polishing runners, carrying the polishing blocks in the same way as the frame b of the apparatus shown in Fig. 156.

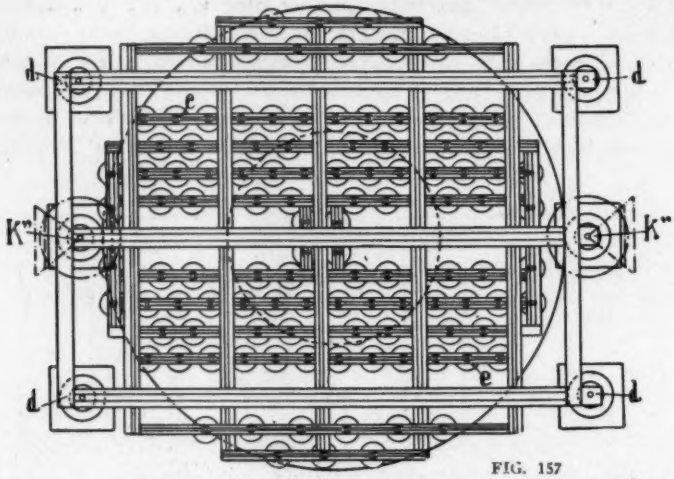


FIG. 157

In the polishing apparatus illustrated in Fig. 160, a design of the St. Gobain Company, all polishing blocks are carried in a single runner which is suspended eccentrically to the table (System Delloye). The king-shaft, as in the corresponding grinding apparatus, turns with 26-28 r.p.m. In the runner the polishing blocks are set close together, but each individual block must be free to move around its suspension and guiding pin. When the runner is lowered, all blocks rest with their weight on the table and the runner rotates together with the latter. The polishing rouge, mixed with water, is admitted from a tank fixed to the hollow shaft of the runner and is distributed from two or three concentric grooves, whence it flows to the table through lead tubes of 1-1¼" clear diameter; there is such a tube in front of each polishing block.

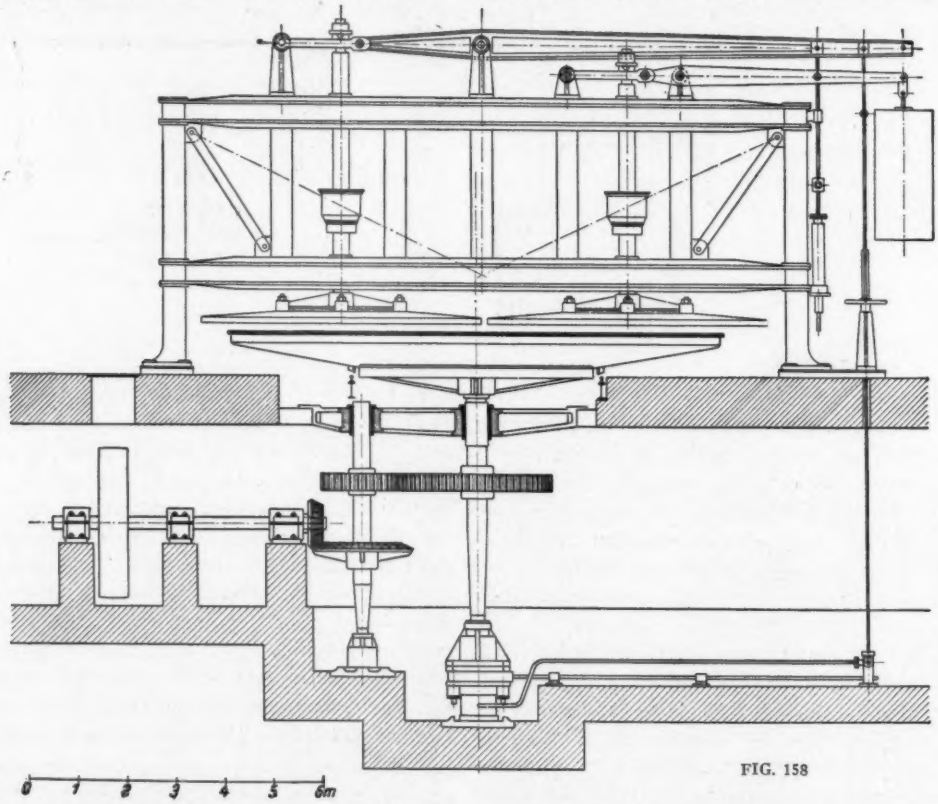


FIG. 158

The grinding machines as described, with 26 to 28 r.p.m.,

with tables of, say, 33 feet diameter, with direct drive by an electric-motor and gear, require between 250 and 550 hp. for grinding and smoothing. During the washing down of the table, the power required temporarily falls to 100 hp. The maximum power is wanted for grinding with sharp sand and when the grinding discs rest with their full weight on the glass surface. If in place of the single gear a

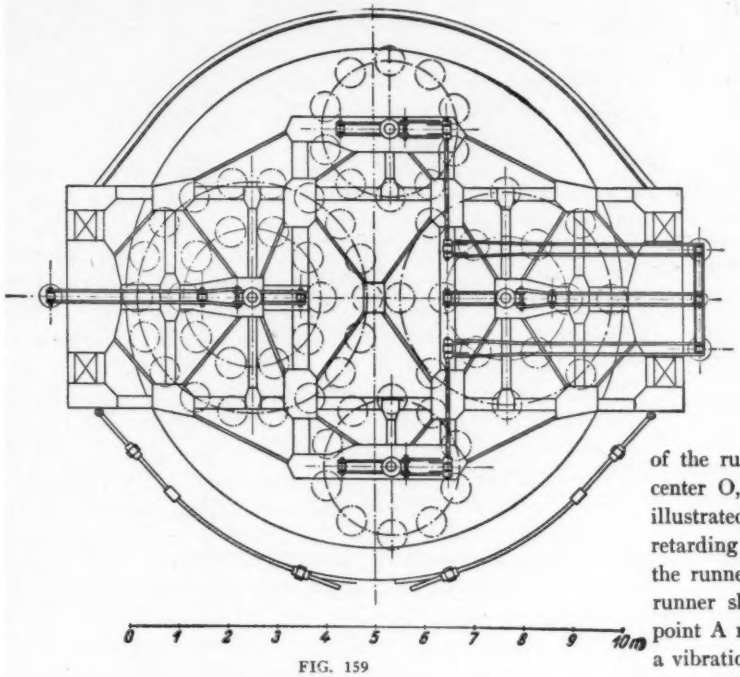


FIG. 159

multiple one or a belt drive is employed, the efficiency of these elements has to be considered. As a rough guide it can be assumed that grinding apparatus use about 0.6 hp. hours and polishing apparatus about 0.5 hp. hours per square foot* of one side of finished glass surface ready for sale, and double this amount for both sides.

Assuming an equal amount of rouge supplied to the table, the polishing effect, generally speaking, is the greater, the greater the eccentricity between table and runner. In Fig. 161, M indicates the axis of the table, O that of the polishing runner and x the amount of eccentricity. Point A

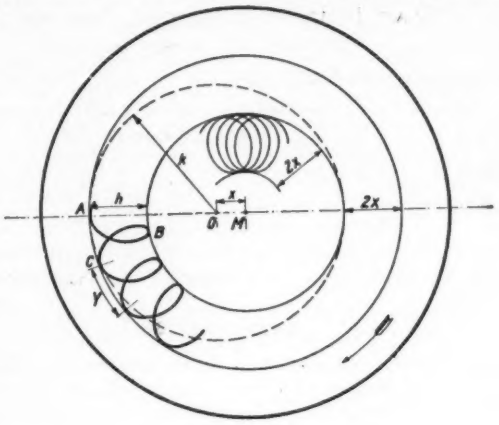
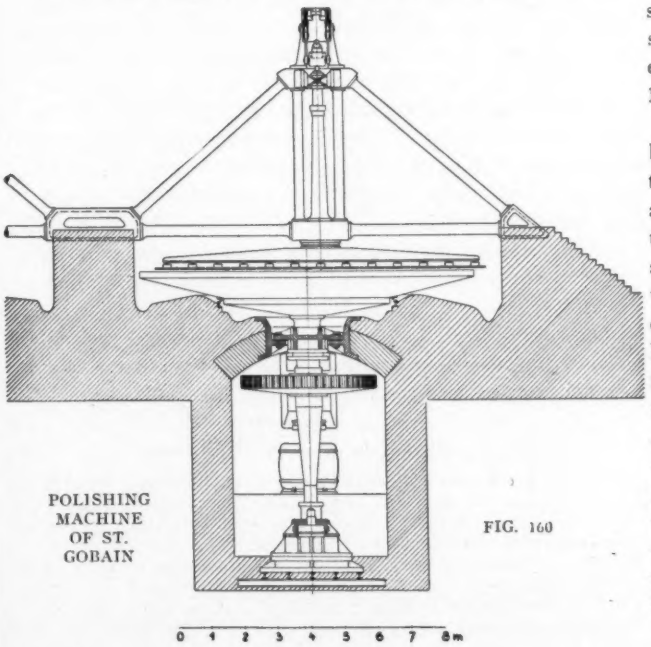


FIG. 161

of the runner moving on a circle with a radius k and the center O, relative to the table surface follows the track as illustrated. This track results from the eccentricity, the retarding influence of the polishing blocks of one-half of the runner on to those of the other, and the friction in the runner shaft bearings. After a full turn of the table the point A moves to B and C and so on. The amplitude h of a vibration is equal to 2 x. The greater h, i.e., the greater x, the greater will be the relative movement between felt and glass. The felts when saturated with polishing rouge make a close contact with the glass surface; the eccentricity is chosen as high as the adhesion between glass and table or rather plaster or cloth, which lie between glass and table surface, will permit,† i.e., not so much that the possibility of stripping the glass from the table is to be feared. The eccentricity, which is employed in practice, varies between 13½ to 18″.

However, the eccentricity is limited in the first instance by the polishing effect near the table edge. The greater the eccentricity, the greater will also be the crescent-shaped area which the polishing runner leaves free on the table and the more polishing blocks will overstep the opposite table side; this again will somewhat release the pressure on the working felts and thus reduce the polishing effect. If the eccentricity of the polishing head goes beyond a certain limit, the polishing effect of the table edge will be lowered near the table edge and be increased towards its center. On the other hand, the polishing effect in the middle will become insufficient if the eccentricity is chosen below a certain value. With a mean eccentricity the polishing effect can be increased by retarding the crown so that the distance which the point A lags behind the table is artificially increased.



POLISHING MACHINE OF ST. GOBAIN

FIG. 160

* In America the grinding usually requires appreciably less than this, and the polishing often requires a little more.—F.W.P.

† As a matter of fact the permissible eccentricity depends more on the diameter of the polishing block than on anything else.—F.W.P.

(To be continued)

Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials and Glass Factory Equipment and Operation

PUBLISHED MONTHLY

Copyright, 1931 by

GLASS INDUSTRY PUBLISHING COMPANY, INC.

24 West 40th Street, New York

Telephone CHickering 4—2354 Cable Address Glasdustry

G. W. Cooper, Managing Editor

Subscription Price.....$2.00 a Year
Single Copy .....20 Cents

THE GLASS INDUSTRY most heartily and sincerely wishes all of its readers (in spite of possible past disappointments) an exceptionally

Merry Christmas

and ventures to broadcast to them on an imaginary "wave," the earnest wish that all will experience substantial fulfillment of their most treasured hopes and aspirations, during the course of a

Happy New Year

Vol. 12 DECEMBER, 1931 No. 12

CONTENTS

	Page
Some Recent Developments in American Glass Manufacture.	235
The Manufacture of Rolled Plate (Continued).....	242
Editorial:	
Your Own Ultraviolet Glass Problem.....	246
Industrial Progress in Twenty Years.....	247
Twelve Acres of Glass Tile for British Tunnel.....	247
Protection for Buyers of Utraviolet Glass.....	248
Proposed Federal Specification for Ultraviolet Ray Transmitting Glass	249
Recent Patents	252
Dralle's "Die Glasfabrikation," Volume II, Available.....	252
Glass World and What It Is Doing:	
Clarence M. Brown Heads Pittsburgh Plate Glass Company	253
Owens-Illinois Announce Executive Changes.....	253
Glass Department at Alfred University	254
R. L. O'Brien New Tariff Commission Chairman.....	254
Tariff Commission's Activities	254
American Window Glass Company Annual Report.....	254
Glassworkers Ask Tariff Increase on Blown Glass.....	255
Short Course Ceramics	255
September and October Plate Glass Production.....	255
Coming Meetings	255
What the World Wants	255
Readers' Wants and Offers	255
Current Prices of Glass-Making Materials	256
Monthly Summary of U. S. Foreign Trade in Glass.....	256
Annual Index to THE GLASS INDUSTRY.....	257

CLASSIFIED BUYERS' GUIDE, PAGE 16
INDEX TO ADVERTISEMENTS, PAGE 18

Reference to the contents of earlier issues of THE GLASS INDUSTRY can be found in THE INDUSTRIAL ARTS INDEX in many Public and Technical Libraries.

Your Own Ultraviolet Glass Problem

DOUBTS prevail more or less strongly in the minds of many persons favorably disposed towards the use of ultraviolet ray transmission glass, as to the wisdom of installing in their homes even a test window, to say nothing of a complete equipment. It is only natural, in view of their own inexperience with, and insufficient knowledge of such matters that they should feel hesitant as to their ability to select and purchase a glass possessed of transmitting power strong enough to insure its usefulness to the purchaser; and the fear of being misled by some unscrupulous dealer into buying some worthless product holds them back from buying any kind.

However, such danger is being minimized and can now be almost entirely avoided if purchasers before placing their orders will refer to the "Proposed Specification of the U. S. Bureau of Standards for Window Glass for Transmitting Ultraviolet Radiation of Certain Wavelengths," prepared by Dr. W. W. Coblentz of the Bureau of Standards, and printed in full in this issue. This will tell them what they must know if they wish to know what they are buying.

Since the use of ultraviolet transmitting glass began to attract public attention the lack of definite and complete knowledge by many citizens concerning such glass and its value as a health promoter, and sometimes as a health restorer, has opened up opportunities for unscrupulous agents to mislead prospective buyers by claiming more merit for their glasses than is in some cases deserved. Earnest efforts have been made by various individuals and concerns interested in promoting legitimately the use of ray transmission glass, to warn prospective buyers regarding certain differences in the efficiency of the different brands, but there are still millions of persons lacking the knowledge to judge correctly the intrinsic value of the product offered them, and there are still unscrupulous dealers ready to foist inefficient imitation products on them. Fortunately, however, so far as the approved makes of this type of glass are concerned, the buyer, as explained above, can now avoid such dangers. Research and experience have progressed sufficiently to make it possible and safe for any convert to therapeutical uses for ultraviolet to be assured that he and his family will be entirely safe and that a reasonable degree of satisfaction will be enjoyed if he will but take advantage before buying, of the information easily available from reliable sources such as that mentioned above.

Additional information of still greater importance on ultraviolet ray transmission glasses in comparison with common window glass will possibly be disclosed after the completion of an important investigation to be made by a well known semi-public organization, concerning which the facts cannot be made public at this time.

Glass and Pottery Show at Pittsburgh

The annual exhibit of glass and pottery at Pittsburgh for 1932 takes place at the Fort Pitt and William Penn Hotels, January 11-21. Unusual interest is being manifested in advance of the meeting and a good attendance is expected. The Fort Pitt Hotel, always a center of attraction, will be practically given over to the glass trade, and as usual most of the overflow of exhibits will be shown at the William Penn Hotel. More than a score of glass manufacturers are already scheduled to exhibit their lines.

Industrial Progress in Twenty Years

F. J. SOLON
General Manager, Owens-Illinois Glass Company

IN the last twenty years we have not only changed our manners, our ways of doing things, but also our point of view. And we have learned a great deal; so much that we are beginning to know that there is a great deal more to learn. In short summary, I think this is principally what we have learned:

1. That no superimposed rules, devices or plans have the motive power of intelligent, individual initiative. The individual to be most efficient should be reinforced by massing of capital and resources and especially for such tasks as need massed production.

2. That, therefore, the fear that the very large corporation with very large financial resources is a potential danger to the community is unfounded. That the large corporation properly managed is needed for our development, and, even improperly managed, cannot cause so much economic harm as small cut-throat units.

3. That it is more economical and, therefore, of greater benefit to the country to have concerns making a limited variety of articles well in quantity than to have these concerns distributing their productive energy among a great number of products. From which it follows that massed production has to be concentrated production. Varied and special production belongs to handicraft or small quantity production. Thus, business will ultimately separate into two divisions. The first will make and sell a few kinds of articles intensively and therefore cheaply. The other will create products and will be more concerned with artistry than price. Those concerns which today fall into neither of these classifications will eventually approximate one or the other.

4. That buying, making, and selling are really scientific operations which demand the interchange of knowledge as among scientists and that there should be available to each man the sum of this knowledge. This conviction, which is becoming general, has been largely brought about by the establishment, growth, and service of publications which act as round tables for the interchange of experiences. America is forging to the front in the knowledge of the science of business because no other country is as well equipped with books and periodicals making available past and present practice. And consequently our knowledge of business is available to everyone and not confined to only a few.

5. That buying, production, and selling continue to combine to a profitable business conclusion only when conducted formally or informally in the light of the largest possible knowledge of industrial, mechanical, chemical, electrical, and allied engineering research. In every event their application has to be tempered by human understanding.

6. That business is always an inter-relation of human beings and, therefore, without a supreme consideration of the human element there can be no satisfactory business.

7. That there has not yet been discovered a scientific method by which the results of industry may be satisfactorily divided between capital and labor.

8. That the line between the rich and the poor is becoming ever hazier. There is a wide separation between the very rich and the very poor, but there is no point in between of positive cleavage. The constant passing from one grade to the next is so easy and so rapid that there is no opportunity to form well defined class distinction and therefore "class consciousness" in the Socialistic sense is achieved through mental perversion.

9. That our standard of living and therefore our consuming capacity have increased so vastly that the possibilities of the home market are such that no man today can chart potential consumption. This fact and the fact set forth in the preceding paragraph are of fundamental importance in thinking of the future of American business.

10. That personal morality and faithfulness—that is, character—form the only solid basis of credit and hence the only basis upon which enduring business can be founded. These qualities of themselves inevitably make for cooperation and mutual helpfulness.

11. That it costs less to resell to old customers than to acquire new ones and, therefore, square dealing and service create the good will which is the highest asset of business.

12. That salesmanship and advertising are essential to healthy business growth, but only as in them science is mixed with art. Purely emotional advertising or forced selling are more harmful than helpful.

13. That an adequate amount of capital is an essential prerequisite to success in business. That it is extremely unsafe and unsound to borrow commercially where the money borrowed will not be liquidated by the conservative conversion of current assets, and also that it is better to build by plowing in profits than by funding obligations. It is distinctly preferable, whenever new money must be had, to secure it on preferred or common stock rather than by the issue of lien obligations.

14. That waste of men, machinery, material, or money is never excusable and is fatal to progress.

15. That we have by no means reached our full business maturity and that our future problem is to learn how to dispose our great strength so that all of it may be effective.

Twelve Acres of Glass Tile for British Tunnel

The huge tunnel for road traffic now being constructed underneath the River Mersey between Liverpool and Birkenhead will be lined with glass panels of a dark green shade. For a long time experiments have been made in order to help the Tunnel Committee to decide on the best form of lining. It is estimated that painting would involve an annual expenditure of between £3,000 and £5,000 ($15,000 and $25,000), but the advocates of painting pointed out that tiles might have to be removed from time to time. Then it was suggested that glass might be used. The area to be covered is approximately twelve acres, and the expenditure on the glass lining will exceed £50,000 ($250,000) at par.

Protection for Buyers of Ultraviolet Glass

Bureau of Standards Proposes Federal Specification for Window Glass for Transmitting Ultraviolet Radiation of Certain Wave Lengths.

ALL glass men do not realize the extent to which the use of ultraviolet window glass may grow. That its use is of benefit in maintaining good health, and in some cases important in the treatment of disease, is recognized by all well informed persons. The exact degree of benefit to the recipient of the health giving rays cannot of course be predicted, but the evidence that ultraviolet treatment *is* beneficial is so strong that a substanial business has already been built up on the records made for this type of glass in hospitals, schools, etc. With the recent establishment of a plant in West Virginia for mechanical instead of hand production, and the consequent lowering of cost the possibilities for greatly increased consumption are substantially enhanced. The use of mercury lamps and other types each requiring a special glass screen for ultraviolet treatment is also being quite rapidly extended.

In the Bureau of Standards Circular 235 (second revision) of September 29, 1927, a transmission of ultraviolet rays for window glass of 2 per cent at 280 millimicrons was specified, in order to assure sufficient transparency at 292 to 302 millimicrons useful for theraupetic purposes, and to distinguish these special glasses from common window glass. Thereupon purveyors of window glasses made the plea that since wavelengths shorter than 290 millimicrons are not present in sunlight, the specification of transparency should be made only in term of wavelengths that are in sunlight.

Since common window glass transmits wavelengths longer than 313 millimicrons, evidently there is no reason for considering the transparency of special window glasses at wavelengths longer than this value.

Hence the wave length 302 millimicrons (an intense, easily obtainable emission line in the mercury arc) was used as a source, as a basis for comparing the ultraviolet transparency of special window glasses. The next question is the specification of the percentage of transmission at 302 millimicrons in order to insure effective therapeutic action . . . What is needed is the best available, and the best is none too effective in the winter time when it is most needed. The author of the article specified that . . . a fair and reasonable requirement is that the substitute for ordinary window glass, after complete solarization, shall have a transmission of not less than 25 per cent of the incident radiation at wavelength of 302 millimicrons. . . . There are many factors that affect the amount of ultraviolet in sunlight such as altitude, latitude, time of day, season of the year, and especially atmospheric pollution by smoke. In view of this situation it appears desirable to use the most transparent glass that can be obtained, especially in sanitariums and permanent sun parlors. For domestic use, with children in the home, where such windows will be needed only a few years, glass substitutes having a high transmission of ultraviolet radiation can be installed and replaced in position yearly at small expense.

MINIMUM TRANSMISSION REQUIRED

Recently the Council on Physical Therapy has raised the minimum transmission requirement of ultraviolet rays for window glass, from 25 to 30 per cent at 302mμ. It is probable that when American manufacturers (there is only one at present) succeed in improving the transparency of their product, this minimum transmission requirement will be raised to a still higher value.—*Bureau of Standards*, 1931.

Reprints have appeared of a paper published in the *Journal of the American Medical Association*, September 20, 1930, Vol. 95, pages 864 and 865. This paper by Dr. W. W. Coblentz, Ph.D. Sc.D., relates to the Specification of Minimum Transmission of Ultraviolet Transmitting Glasses.

In Part I of this reprint the Spectral Range of Therapeutic value is discussed. The author points out that it is commonly observed that rickets develop when ordinary window glass is used in solariums and sun boxes, whereas healing is effected when glasses are used that freely transmit the short wavelength ultraviolet rays that are shut out by common window glass. . . . Physical tests show that common window glass transmits only 1 to 2 per cent at 313 millimicrons and is completely opaque to radiation of shorter wavelengths, which, in the average sea level sunlight, extend to about 295 millimicrons in summer and to about 305 millimicrons in winter. The therapeutic range of the ultraviolet in average noonday sea level sunlight is therefore only 10 to 15 millimicrons in width. . . . The shortest wavelengths in sunlight appear to produce the greatest biologic action, and the tests cited with common window glasses show that solar wavelengths longer than 313 millimicrons have no specific biologic action.

Part II treats of Specification of the Minimum Transmission of Window Glass. When the special window glasses for transmitting short wavelength ultraviolet were first introduced, it was evident that the time would come when it would become necessary to establish some criterion to distinguish them from common window glasses; hence the investigations leading to the preparation of the accompanying proposed specification of the Bureau of Standards.

A copy of the Bureau of Standards Proposed Federal Specifications for Window Glass for transmitting ultraviolet radiation of certain wavelengths appears in full below, together with the Bureau Circular dated October 1, 1931, supplementing PC 113 and showing the average per cent transmission developed in recent tests of Brephos, Corex D, Cosmos, Helioglass, Quartz glass, Sunlit, Uviol-Jena, and Vitaglass specimens, before and after exposure at a distance of 15 feet, to a 110-volt horizontal Uviarc quartz mercury lamps for 10 hours.

Data on the ultraviolet transparency of various kinds of glass and organic substitutes for window glass (Vita-glass,

Sunlit, Helioglass, Uviol Jena, Neuglas, Corning Corex D, Quartz, Celoglass, Cellophane, Tracing cloth, etc.) are given in Bureau of Standards *Research Paper No.* 113, entitled "Data on Ultra-violet Solar Radiation and the Solarization of Window Materials," which is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents per copy, prepaid.

Data on the amount of ultraviolet solar radiation available for therapeutic purposes at various hours of the day and different seasons of the year, are given in Bureau of Standards Research Papers Nos. 318 and 370, obtainable from the Superintendent of Documents, at 10 cents per copy, prepaid.

The following Circular Supplementary to Bureau of Standards PC 113 was recently issued at Washington:

WASHINGTON, October 1, 1931.

DATA ON RECENT PRODUCTIONS OF SPECIAL WINDOW GLASSES FOR TRANSMITTING SHORT WAVELENGTH ULTRAVIOLET SOLAR RADIATION

Research Paper No. 113 gives average transmissions at 302mμ of samples of window glasses produced prior to February 1, 1929. The data given in the table below are similarly, averages of samples of various makes of special window glasses obtained at the time indicated in column 6 of this table.

It is believed that with the issue of this additional information, the value of attempting to rate the brand of material instead of the finished product is exhausted. This is commonly true with all kinds of products and especially so with glass which is known to vary from melt to melt in spite of the most careful supervision. The purchaser may protect himself by having the dealer contract to furnish glass whose transmission shall, after stabilization by exposure, not fall below an agreed value at 302mμ. Tests of glasses that have been solarized for 3 to 4 years show that, after exposure to the summer sun for about 2 months, the transmission remains constant; see column 5 of table.

TABLE

Per cent transmission of various glasses at 302 mμ, when new and after exposure at a distance of 15 cm. from a 110-volt horizontal Uviarc quartz mercury lamp for ten hours; and of duplicate samples exposed to the sun and weather since the date indicated in column 6. Thickness of glasses, 2.3 mm.

Trade Name (1)	No. of Samples Tested (2)	Average Per Cent Transmission — New (3)	After Exposure to Lamp (4)	After Exposure to Sun (5)	Since: (6)
Brephos	3	68	50	58	Mar., 1931
Corex D.....	3	61	59	60	Jan., 1929
Cosmos	2	72	45	57	May, 1931
Helioglass	8	64	45	53	Dec., 1929
Quartz glass....	1	92	92	92	.....
Sunlit	6	72	47	55	Aug., 1930
Uviol-Jena	3	58	39	48	Apr., 1929
Vitaglass	3	63	31	43	Mar., 1931
Vitaglass	15	58	33	42	May, 1930

NOTE: Standard thickness Lustraglass transmits 15 to 20 per cent at 313mμ when new (10 to 15 per cent after exposure to the sun) where common window glass transmits about 1 per cent. At 302mμ, Lustraglass transmits about 2 per cent, while the first six special glasses, listed [in the first paragraph on this page] above, transmit upwards of 40 per cent.—*Bureau of Standards*, 1931.

Proposed Federal Specification for Ultraviolet Ray Transmitting Glass

SUBMITTED for our readers by the Federal Specifications Board, George K. Burgess, Chairman, which will be glad to receive any comments or suggestions as to changes which may be thought to be desirable in the specification. Such comments or criticisms will have to be received by the Board not later than ten weeks from November 20 if they are to receive attention of the Technical Committee considering this subject.

October 10, 1931.
Revised October 28, 1931.

A. Preamble.

There is no other Federal Specification applicable to this specification.

B. Types.

B—1. Glass covered by this specification is of one type only, viz., clear window glass for transmitting ultra-violet radiations of wave lengths and in amounts specified herein. It is transparent, relatively thin, flat glass having glossy, fire finished, apparently plane and smooth surfaces, but having a characteristic waviness of surface which is visible when viewed at an acute angle or in reflected light.

C. Material and Workmanship.

C—1. See E.—Detail requirements.

D. General Requirements.

D—1. The glass must transmit at least 25 per cent of the incident radiation of wave length 302 milimicrons after stabilization as described in Section F—3a.

D—2. Small lights must be quite free from imperfections as compared with larger ones, and the center of any sheet should be clear, whereas the edges may contain more pronounced defects.

E. Detail Requirements.

E—1. Dimensions.

E—1a. Glass must be cut to within 1/32 inch of the dimensions ordered. Maximum dimensions recommended for glazing purposes are 40 x 50 inches.

E—1b. Thickness.

The minimum thickness of the glass shall be 0.08 inch and the maximum shall not exceel 0.111 inch unless otherwise specified.

E—1b (1). The thickness, measured at various points on individual sheets, shall not vary more than 0.01 inch.

E—2. Flatness.

All glass shall be relatively flat. Slight curvature, provided it is regular, will be allowed, but the maximum deformation or bow shall not make an arc higher than 0.5 per cent of the length of the sheet. Reverse curve or crooked glass is not allowable.

E—3. Quality.

The glass must be at least B quality as defined in Federal Specification DD—G—451 dated April 28, 1931, and from which the following has been adopted:

The glass may contain some seed. Occasional scattered bubbles and blisters not more than 0.5 inch long may occur over the central area of the sheet. Larger blisters up to one inch in length may occur about the bordering areas.

Waves should not be of such intensity that they are visible when observing the sheet at an angle greater than 45° with the glass unless on the border.

Burn spots may be visible when looking directly through the glass, but they must not cause any appreciable depression, and the speckled appearance must not be so great as to interfere with vision when examining the glass in the specified position. (See F—2.)

E—4. Ultra-Violet Transmission.

The transmission of any sheet of glass after complete stabilization by exposure to a quartz mercury arc lamp shall be not less than 25 per cent of the incident radiation of wave length 302 millimicrons. (See F—3.)

E—5. Weather Resistance or Stability.

E—5a. The glass shall be of such composition that it will not weather, scum or otherwise deteriorate after installation more than ordinary sheet glass of recognized good quality.

E—5b. No sheet of glass shall be acceptable if, upon removing it from a box, such sheet shows visible permanent scumming, weathering or surface deterioration. These defects are hereby defined as a surface blemish that persists after washing the glass with water and a soft cloth followed by careful and thorough drying and examination after having been kept in a dry room for at least 24 hours. (See I—3.)

F. Method of Sampling, Inspection and Test.

F—1a. Sampling for "quality" as described in E—3.

Acceptance or rejection of a shipment or delivery shall be based on an examination, for quality, of the following quantities: For orders of 100 lights or less, all shall be examined; for orders of 101 to 500 lights, at least 50 per cent shall be examined; for orders of 501 or more lights, at least 25 per cent shall be examined. Boxes shall be selected from the shipment at random.

If not more than 10 per cent of the lights examined are below quality, the shipment shall be accepted, provided the lights below the specified grade are not distinctly below the upper limit of the next lower grade. If, however, an entire shipment of 500 lights or more is examined, not more than 5 per cent may be below quality.

F—1b. Sampling for ultra-violet transmission test.

One sample of glass for this test, at least 6 by 6 inches square, shall be taken from every 100 sheets or fraction thereof. These samples should be so selected that they are relatively free from cords, bubbles, etc., in order to secure satisfactory samples for the test.

F—1b. (1). Additional samples may be taken for this test when, in the opinion of the inspector, it seems advisable.

F—2. Inspection.

F—2a. The method of examination is described in these specifications in order to make the results more uniform and defines the condition under which glass should be examined, because the distance from the glass, the angle between the glass and the line of sight, and the intensity of light all affect the visibility of imperfections. These specifications should be interpreted by examining the glass in the following manner, with reference to the definitions of defects listed in Notes (I—8).

F—2b. The glass should be examined when placed in a position similar to that of a glazed light with the observer's eye on a level with the center of the sheet and looking through the glass from a distance of about 36 inches into the light from a clear sky without any sun or any close background.

F—2c. The visibility of waves, lines, or cords depends chiefly upon the angle of observations, and the intensity of these defects can be classified on this basis. The values given for angles are the angles the line of sight makes with the sheet of glass when in a vertical position. Slight movement of the head horizontally through an angle of two or three degrees will make waves or lines more perceptible.

F—3. Transmission Test.

F—3a. Stabilization of Transmission.

The stabilization of the ultra-violet transmission of the glass shall be accomplished by exposure to a 110-volt horizontal quartz mercury arc lamp, having a tungsten anode and consuming about 300 watts in the burner. A 110-volt vertical quartz mercury arc lamp, having a tungsten anode and consuming about 300 watts in the burner, may be used instead of the horizontal burner provided the distance and other requirements are fulfilled.

The samples of glass, cut to a size of not less than 1 by 2 inches shall be placed upon a horizontal wooden support, below and lengthwise with the axis of the lamp, at a distance of 15 cm. from the underside and midway between the ends of the burner. The sample shall be exposed to the direct rays from the lamp, no filter intervening, for at least 10 hours or for such additional time as may be necessary to insure complete stabilization. Only one side of the glass shall be irradiated.

F—3b. Ultra-Violet Transmission Test.

The source of radiant energy for determining the ultra-violet spectral transmission shall be a quartz mercury arc or other source emitting an intense and preferably discontinuous spectrum.

If a high-powered (2,000 to 3,000 watt) gas-filled tungsten lamp (which is especially strong in infra-red radiation) is used as a source of ultra-violet radiation, then especially precautions shall be taken to eliminate the effect of stray visible and infra-red radiation from the measurements in the ultra-violet.

Any method recognized as efficient by the United States Bureau of Standards may be used for determining the ultra-violet transmission. If the spectroradiometer is used, its optical parts should be of quartz or other material transparent to the extreme ultra-violet. To eliminate the effect of stray radiation, especially in the extreme ultra-violet, the shutter which is used in admitting the radiation of the source into the spectroradiometer while taking the zero readings should be of red or yellow glass that is opaque to ultra-violet radiation.

F—3c. Report of Transmission Test.

The report of the transmission tests must state definitely (1) the transmission and thickness of each sample tested, and (2), based on the individual tests, the average maximum thickness of such glass that can have the required transmission. (See E—4.) Glass thicker than this maximum will not meet the requirements of this specification and should be rejected. (See I—2.)

G. Packaging, Packing and Marking.

G—1. Any special requirements of inlividual departments are noted under Section H.

G—2. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G—3. Marking.—Each container shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the dimensions and quality of the contents, and some means of identification of the particular contract on which purchase and shipment were made.

H. Requirements Applicable to Individual Departments.

H—1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H—1a. Army: Marking.—United States Army Specification No. 100-2, Standard Specification.

H—1a (1). Packing.—For domestic shipments, current commercial packing which will insure delivery in good order. For export. War Department Specification for export packing current on the date of circular proposal.

H—1b. Navy Department: General Specification for Inspection of Material (copies of which may be obtained without cost upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.).

H—1b (1). Plate glass shall be carefully and securely crated so as to prevent breakage.

H—1b (2). Glass up to 100 united inches shall be packed 50 square feet per box, glass over 100 united inches shall be packed about 100 square feet per box.

H—1b (3). Shipping containers shall be marked with the name of the material, the type, the size, and the quantity contained therein as described by the contract or order under which shipment is made, the name of the contractor, and the number of the contract or order.

H—1c. Marine Corps: Instructions issued by the Quartermaster's Department.

H—1d. Panama Canal: Packing.—Glass to be securely boxed to insure against breakage due to rough handling in ocean shipment, the different panes of glass to be separated by a thin sheet of paper. Sides, tops, and bottoms of boxes to be made of good-grade lumber not lighter than 5/8-inch thick. Ends or heads of cases to be made of S2S 7/8-inch thick hardwood. Sides to be adequately braced on outside with not less than two 5/8-inch by 3-inch battens. Ends to be adequately reinforced on outside with not less than two 5/8-inch by 3-inch cleats. Boxes to be well nailed with seven-penny cement-coated nails. All nails to be clinched on inside.

All space between glass and inner walls of boxes shall contain sufficient straw or excelsior to prevent contact between glass and any portions of the lumber used in the construction of the boxes.

H—ld (1). Alternative bid: If bidders desire to use their standard method of export packing for glass, and consider same equal or superior to the above specifications, they may submit alternative proposals based on such standard method of export packing. In case such alternative proposals are submitted, bidders should state in detail the method of packing proposed, such statement to be written on separate slip and pasted on the margin of this class. The Panama Canal reserves the right to reject such alternative bids if it does not consider the method of packing satisfactory.

To insure shipment of glass on the edge instead of flat, boxes shall be properly marked "Glass; this side up."

I. Notes.

I—1. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, but no bids should be considered unless accompanied by definite evidence that the brand of glass the bidder proposes to furnish should meet the requirements of this specification. Furthermore, no glass should be installed before samples taken from delivery have been shown to have the required transmission.

I—2. The ultra-violet transmission of glass varies inversely with the thickness of the glass. As a first approximation, for transmission values of 25 per cent or more, the transmission decreases about 1.4 per cent for every 0.1 mm. increase in thickness; conversely the transmission will increase about 1.4 per cent for every 0.1 mm. decrease in thickness. For example, if a piece of glass 2 mm. thick normally transmits 25 per cent, any thicker piece of similar glass would transmit less than 25 per cent; if the thicker piece were 2.5 mm. in thickness, then its transmission would be approximately 18 per cent. Conversely, if a piece of glass 2.8 mm. thick transmits 25 per cent, a piece of similar glass 2.0 mm. thick would transmit approximately 36.2 per cent.

The above figures are only indicative of the general trend in changes of transmission with thickness and are roughly correct. Values of maximum thickness referred to in F—3c must be obtained by more complex computations.

I—3. The glass described in this specification should not be purchased and placed in storage, but should be installed as soon after delivery as possible. This procedure is recommended to avoid possible loss to the Government which might occur if the glass were not properly packed and stored.

I—4. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I—5. Interested parties are advised that an Alphabetical Index of Federal Specifications may be obtained upon application, as noted in paragraph next below, at a cost of 5 cents.

I—6. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents.

I—7. The various terms used in describing imperfections appearing in flat glass are the following: Seeds, boil bubbles, blisters, open bubbles, cords, strings, ream knots, scratches, light grazes, cullet cuts, sand lash, sleck, short finish, sand holes, feathers, skim, stones, waves, lines, burns, burn spots, and fire cracks.

Many of these terms may be grouped under one general term, and a number are not necessary in preparing specifications, although they are often used in a factory as identifying certain imperfections.

I—8. Definitions, causes, and brief description of these various imperfections are given herewith.

Bubbles.—Gas inclusions in any rolled glass. These inclusions are practically always spherical and brilliant in appearance. The term applies to all such inclusions larger than 1/32-inch in diameter. The term small bubbles (commonly known as boil) refers to sizes between 1/32-inch and 3/32-inch.

Seeds.—Minute bubbles less than 1/32-inch in diameter. Fine seeds are visible only on close inspection, usually appearing as small specks and are an inherent defect in the best quality of plate glass. Seeds about 1/64- to 1/32-inch in diameter are usually considered as coarse seeds.

Heavy seeds.—Refers to a condition when the fine and coarse seeds are very numerous, such as 25 or more to the square inch.

Scattered seeds.—Indicates a condition of few and occasional easily visible coarse seeds. Two or three may be spaced 1 or 2 inches from each other, but one here and there at much greater distances apart is the usual intention of the term.

Open bubbles.—Bubbles which have been broken into by grinding, leaving a hemispherical hole in the glass surface.

Blisters.—Elongated bubbles or seeds, elliptical in shape. This form of bubble is generally peculiar to window glass but may be found in plate glass manufactured by recently improved methods. In both cases the method of manufacture draws out practically all bubbles in one direction.

Skim.—Streaks of dense seed with accompanying small bubbles.

Strings.—Wavy, transparent lines appearing as though a thread of glass had been incorporated into the sheet.

Cords.—Heavy strings incorporated in the sheet, occurring without any regularity of direction, and apearing to be of considerable thickness rather than on the surface.

Ream.—An area of unhomogeneous glass incorporated in the sheet producing wavy appearance.

Scratches.—Any marking or tearing of the surface appearing as though it had been done by either a sharp or rough instrument. Scratches occur on sheet glass in all degrees from various accidental causes.

Short finish.—Insufficient polish or lack of brilliancy; improperly finished surface which has the appearance of being slightly pitted and wavy when the surface is viewed in reflected light. These indentations, which are slight, have a polished rather than a ground surface, but the general effect is a slight dulling of the surface. Poor polish is usually caused by improper grinding.

Stones.—Any opaque or partially melted particle of rock, clay, or batch ingredient imbedded in the glass.

Lines.—Waves which extend continuously across the sheet, so that the reflection from the surface appears as a line or series of lines extending either the full width or a considerable distance across the sheet.

Burns.—Small projections or indentations on the surface appearing as an area of small specks, together with some destruction of the surface polish. An imperfection occurring during the flattening of window glass caused by flattening furnaces becoming too hot.

Fire cracks.—Small cracks penetrating the surface of the sheet. Usually in the shape of short hooked crescents. Caused by sudden heating or chilling of the surface.

Sand holes.—Rough spots on the polished surface produced during coarse grinding, which fine grinding did not later remove owing, to some extent, to coarse grains of grinding sand becoming mixed with finer grades.

Central area of sheet.—This term is used with slightly different interpretation with reference to plate or window glass. In plate glass the central area is considered to form an oval or circle centered on the sheet whose axes or diameters do not exceed 80 per cent of the over-all dimension. This allows a fairly large area at the corners, which may have imperfections not allowed in the central area.

In window glass the central area is considered as being a circle having a diameter equal to half the width of the sheet or an ellipse having one diameter equal to half the length of the sheet and the other diameter equal to half the width of the sheet.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Germany's Foreign Trade at Highest Peak

German foreign trade including imports and exports for the month of October as compared with September showed, according to the *New York Times*, a surplus of exports topping the record surplus of September by $2,000,000 and setting another all-time mark. A total for the first ten months of the year amounted to $562,000,000.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,829,738. Nov. 3, 1931. Carroll Cone and Edwin A. Robin, Toledo, O., assignors to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 2/14/29.

SHEET GLASS DRAWING APPARATUS. U. S. 1,831,639. Nov. 10, 1931. Joseph A. Reece, Toledo, O., assignor to Libbey-Owens-Ford Glass Co., Toledo, O. Filed 7/30/27.

APPARATUS FOR SURFACING SHEETS OF GLASS AND THE LIKE. U. S. 1,831,634. Nov. 10, 1931. Ingvald O. Pedersen and Erik G. Stahle, Pittsburgh, Pa., assignors to Libbey-Owens-Ford Glass Co., Toledo, O. Filed 8/24/27.

PROCESS AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,831,623. Nov. 10, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Co., Toledo, O. Filed 2/2/28.

PROCESS AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,831,620. Nov. 10, 1931. Carroll Cone, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 11/30/29.

PROCESS AND APPARATUS FOR PRODUCING MOLTEN GLASS. U. S. 1,831,619. Nov. 10, 1931. Horace E. Allen, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 5/23/27.

APPARATUS FOR PRESSING GLASS ARTICLES. U. S. 1,831,548. Nov. 10, 1931. Edwin E. Slick, Pittsburgh, Pa. Filed 10/5/28.

APPARATUS FOR SPRAYING GLASS, ETC. U. S. 1,831,535. Nov. 10, 1931. John Henry Juers, Passaic, N. J., assignor to Triplex Safety Glass Co. of North America, New York. Filed 7/25/29.

GLASS FORMING ROLL. U. S. 1,813,142. July 7, 1931. Louis Boudin, St. Gobain, France, assignor to Societe Anonyme des Manufactures des Glaces & Prcduits Chimiques de Saint-Gobain, Chauny & Cirey, Paris, France. Filed 6/25/28.

PROCESS OF ROLLING SHEET GLASS. U. S. 1,831,060. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Co. Filed 7/14/28.

PRODUCTION OF GLASS IN STRIP FORM AND APPARATUS THEREFOR. U. S. 1,831,015. Nov. 10, 1931. Ernest Bristow Le Mare, St. Helens, England, assignors to Pilkington Brothers Limited, Liverpool, England. Filed 4/27/29 and in Great Britain 5/1/28.

WINDOW GLASS. U. S. 1,830,887. Nov. 10, 1931. Fred W. Renz, Indianapolis, Ind. Filed 1/18/28.

METHOD OF FEEDING GLASS AND MEANS THEREFOR. U. S. 1,830,849. Nov. 10, 1931. William J. Miller, Swissvale, Pa. Filed 5/3/26.

MANUFACTURE OF SHEET GLASS. U. S. 1,830,788. Nov. 10, 1931. Laurence P. Forman, Oakmont, Pa., assignor to American Window Glass Co., Pittsburgh, Pa. Filed 2/2/30.

SHEET GLASS APPARATUS. U. S. 1,828,832. Oct. 27, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 10/27/26.

GLASS MELTING FURNACE. U. S. 1,828,830. Oct. 27, 1931. Joseph P. Crowley, Toledo, O., assignor to The Libbey-Owens-Ford Glass Company, Toledo, O. Filed 9/17/25.

GLASS MELTING FURNACE. U. S. 1,828,833. Oct. 27, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 12/6/26.

PROCESS OF PRODUCING SHEET GLASS. U. S. 1,828,834. Oct. 27, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 7/27/28.

METHOD AND APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,828,835. Oct. 27, 1931. John L. Drake and William E. Nobbe, Toledo, O., assignors to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 12/20/28.

SHEET GLASS DRAWING APPARATUS. U. S. 1,828,845. Oct. 27, 1931. Joseph M. Neenan, Charleston, W. Va., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 12/15/26.

METHOD AND APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,829,409. Oct. 27, 1931. Charles B. Kingsley, Clarion, Pa., assignor to Mississippi Glass Co., New York. Filed 2/28/27.

METHOD AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,829,639. Oct. 27, 1931. Enoch T. Ferngren, Toledo. O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 10/12/22.

METHOD AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,829,640. Oct. 27, 1931. Enoch T. Ferngren, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 3/24/24.

METHOD OF MAKING THE BORDER SEAL OF LAMINATED GLASS. U. S. 1,829,647. Oct. 27, 1931. Robert W. Hackett, Kirklyn and Arthur G. Worrall, Wyncote, Pa., assignors to Louis J. Kolb, Philadelphia, Pa., trading as Safetee Glass Company. Original application filed 5/25/28. Divided and this application filed 8/5/30.

MACHINE FOR FORMING HOLLOW GLASSWARE. U. S. 1,832,810. Nov. 17, 1931. August Kadow and Thomas A. Bragg, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 7/10/29.

GLASSWARE FORMING MACHINE. U. S. 1,832,814. Nov. 17, 1931. John E. McLaughlin, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 7/10/29.

Dralle's Die Glasfabrikation Volume II Available

A Preliminary Review

The second volume of this well known and highly valued publication has been published by R. Oldenbourg, Munich, Germany. In the first volume Robert Dralle left a very valuable work for the glass industry. It was not an easy matter for the publisher and his assistants on the new issue to revise and further develop the valuable information contained in the first volume. Their purpose in bringing out Vol. II has been to create out of the material contained in Vol. I an entirely new book. They have built it up out of the best of Mr. Dralle's material, keeping those portions of the matter which are still applicable to present conditions, revising some and adding a large amount of new matter. Special attention has also been given to systematizing as much as possible both the old and new matter.

Volume I contained in 9 chapters the basic principles and methods of manufacturing glass from a general point of view, while Volume II in 7 further chapters goes more into detail on the various branches of the industry.

In developing this book many difficulties were encountered since the theory and practice of glassmaking has been continuously changing with greater rapidity perhaps than any other industry. This is particularly true in the blown glass fields. The extraordinary success of the Owens vacuum machine a few years ago resulted in bottle manufacturing becoming a mass production industry and also opened up the way for other inventions. Following it has come a variety of equipment and working methods to satisfy the varied demands of the market.

Similar changes have taken place in the plate glass field. Prior to the war the low wages prevailing in the plate glass industry retarded in Europe the use of mechanical processes. Now, however, the old methods of making thick plate and mirror glass have been almost completely discarded and new methods and equipment devised for the making of thin polished plate to meet the demand for laminated safety glass.

Both the Fourcault and Colburn methods and the comparatively new Bicheroux process are now being used in America for this purpose on a large scale. The Pittsburgh Plate Glass Company has also developed a third method incorporating the continuous process of grinding and polishing the glass. The old Lubbers method making window glass has been almost completely superseded by these new developments.

In the authors' efforts to make the history of glassmaking as complete as possible it was necessary to go back into the developments of the past to make understandable the present situation. For this reason some of the older methods have been demonstrated on a more comprehensive scale than might be deemed necessary in view of the practical obsolescence of some of these methods.

In bringing out this issue the publishers have taken pains to include nearly 1,400 pictures which with a few exceptions are entirely new in this edition. The new volume also gives more attention to the literature of the industry than the first edition. A technical index containing 1,300 items is also included.

The price at which this volume will be sold in the United States will be announced in a later issue of this journal.

The Glass World and What It Is Doing

News of the Industry

Clarence M. Brown Heads Pittsburgh Plate

During the past month Clarence M. Brown has been receiving congratulations all through the trade on his election as chairman of the board of directors of the Pittsburgh Plate Glass Company.

CLARENCE M. BROWN

Mr. Brown has long been connected with the company as general counsel, as a director and vice-president for a number of years. He knows the plate, window, and art glass manufacturing business from a to z. He is an able lawyer with a broad knowledge of industrial, commercial and financial affairs.

HAROLD F. PITCAIRN

At the same time the directors elected Harold F. Pitcairn, who for some time has been connected with the efficiency department of the company, to the directorate. Mr. Pitcairn is the third son of the late John Pitcairn, who was successively president and chairman of the board of directors of the Pittsburgh Plate Glass Company. His son Harold is a noted aviator, president of the Autogiro Company of America, of Pitcairn Aircraft, Inc., and of the allied aeronautical interests which bear his name. It was he who brought the autogiro to America and he is sponsoring its commercial development in this country.

Owens-Illinois Announce Executive Changes

Important changes in the general organization of Owens-Illinois Glass Company were announced early in November by President William E. Levis. Harold Boeschenstein, who has been associated with the organization and its predecessors for 11 years, becomes vice president and assistant general manager. He is succeeded by F. J. Solon, who takes the position of general sales manager. Despite their considerable experience in the glass business, both men are relatively young, neither having yet attained the age of 40. Their promotion comes as a further expression

HAROLD BOESCHENSTEIN

of the Company's policy of developing its executives from men within the organization rather than seeking them outside.

At the same time, two other advancements were announced. Smith L. Rairdon is now placed in charge of the pharmaceutical and proprietary sales, while Stanley J. McGiveran assumes charge of sales of prescription ware. These promotions will not involve any substantial changes in their present duties, as for some time past they have been doing virtually the work that will be required of them under the new line-up.

The company's sales volume, while somewhat under that of last year, is holding up very well in the face of existing conditions. The company has just announced the retirement of an additional $500,000 of its 5% ten year debentures out of treasury funds. This leaves only $2,000,000 out of an original issue of $5,000,000 now outstanding. The company's earnings for the 12 months ended September 30, 1931, were $2,792,840.87 which is

F. J. SOLON

Mr. Solon makes his bow as an author to the readers of this journal on another page of this issue.

at the rate of $2.51 per share on the outstanding common stock, after providing for interest on the company's debentures and dividends on the 6% preferred stock.

Glass Department at Alfred University

The new building for the School of Ceramics at Alfred University, Alfred, N. Y., is well under way. It is expected to be opened for occupation September, 1932. The contract was let last spring. The building stands between the present Ceramic building and the Agricultural School building. Its frontage is about 61 feet and it will contain about 26,000 square feet of floor space. The sub-basement will house the glass shop and laboratory which is to be occupied by the new department of glass technology. There will also be a clay shop, plaster shop and laboratory for testing materials. The design for the lobby is planned to emphasize the fact that the building is essentially ceramic, from the leaded glass fanlight over the door to the decorative tile panels. When the school opened in 1900 the faculty consisted of 2 members, Director Charles F. Binns, who has been in charge continuously since then, and one "instructor in graphics and decorative art."

Now, in 1931, there are 10 members on the teaching staff. In 1921 there were 15 students, the number of which has increased to 62 art students and 104 engineers, totaling 166 registered in the ceramic courses.

Eighty graduates and students attended the Alfred dinner held at the Cleveland convention of the American Ceramic Society.

R. L. O'Brien New Chairman Tariff Commission

In succession to Henry P. Fletcher, whose resignation as Chairman of the Tariff Commission became effective December 1 and who will head the American delegation to the Arms Conference to be held at Geneva, is Robert Lincoln O'Brien, a journalist of note and formerly secretary to President Cleveland. The new chairman was born in Abington, Mass., in 1865 and graduated from Harvard in 1891. He holds honorary degrees of Doctor of Literature from four colleges and Boston University.

For several years Mr. O'Brien was Washington correspondent for the *Boston Transcript* and later became editor of that paper. For four years he was president and director of the Boston Publishing Company, proprietor of the Sunday *Boston Herald* and the *Evening Traveler*. He is a member of the Advisory Board of the Columbia University School of Journalism, Phi Beta Kappa, member of the Massachusetts Historical Society and the Gridiron Club of Washington.

How soon Mr. O'Brien will take steps to fill the vacant place on the Commission created by the death of Alfred P. Dennis is not known. When completed the Commission will have three Republican members and two Democrats. Among the candidates for the vacancy is Frank Clark of Florida, for 20 years and until 1928 a member of Congress. The South is anxious to have a member to represent the cotton and tobacco belts.

Tariff Commission Activities

The U. S. Tariff Commission, according to the *United States Daily*, has from the date it was reorganized and November 30, to the date on which the resignation of Chairman Henry P. Fletcher became effective, disposed of 92 cases such as separate rate investigations, surveys and applications. Mr. Fletcher in a letter to President Hoover stated that cost data obtained by the Tariff Commission before certain countries suspended the gold standard has been rendered inapplicable because of changed conditions. Thirty-nine separate rate investigations and 11 important surveys not involving rate changes have been completed. Nine investigations were discontinued; eight were dismissed by Senate resolutions; five applications were withdrawn by proponents; twenty-eight applications were dismissed by the Commission after preliminary investigation. The Commission still has on its calendar ten rate investigations and one survey, all originating in Senate Resolutions and eight others, making a total of nineteen investigations and surveys in progress. Two applications for investigation are on file. Hearings have been held and reports transmitted to the President on various investigations including window glass (Sen. Res. 313) gauge glass tubes, application 79, blown glass tableware (Sen. Res. 330) application 28. Among the list of applications withdrawn, denied or dismissed without prejudice was one on crude barytes ore. The following resolutions are under way and mostly nearing completion: Senate Resolution 324 casein, Sen. Res. 390 application 40 non-edible gelatin and glue, Sen. Res. 458. An investigation on flourspar is being given preliminary attention.

American Window Glass Company Annual Report

The American Window Glass Company's annual report for the year ended August 21, 1931, was issued to stockholders on October 21 by President W. L. Monro. The company's window glass sales during the fiscal year were almost as great as during the previous year, but the greatly reduced prices which prevailed resulted in a net loss for the year of a trifle over $1,700,000 including a loss of approximately $91,000 from manufacturing operations.

The surplus on August 28, 1931, was reduced to $46,028 compared with a surplus of $1,733,455 during the previous year. Inventory during the last fiscal year was reduced by approximately one and a half million dollars. Current assets amounted to $2,545,514 against liabilities of $161,165. A valuation of $17,272,000 is placed on plants, real estate, and good will. Capital stock to the value of $17,000,000 is included in the liabilities account.

The president reported that the Belle Vernon factory operated continuously throughout the year with very gratifying results. The Arnold factory was only operated part time. Factory costs were considerably less than for the previous year. Two different modified Fourcault machine types designed by the company's engineers were tried out; one at the Belle Vernon factory and the other at Arnold, which were the only two of the company's plants operated during the fiscal year. The Belle Vernon factory was closed down since the close of the fiscal year for cold repairs after an almost continuous run of two years. Mr. Monro further stated that efforts to eliminate the green tint characteristic of all common window glass had been so successful that the difference in color of the company's special Lustra glass when compared with the color of any other window glass made is great enough to enable the buyer to distinguish Lustra glass without any other examination.

During the annual meeting, A. E. Nieman of Pittsburgh was elected a director succeeding the late George M. McCandless. The other directors are W. L. Monro, A. E. Braun, James D. Callery, Thomas F. Hart, James D. Rhodes, H. N. Van Voorhis, J. A. Haberkorn and W. L. Monro, Jr.

Glassworkers Ask Tariff Increase on Blown Ware

The American Flint Glass Workers Union filed a brief on November 5 before the Tariff Commission asking for an increase of 50% on imported blown glassware or that the duties be adjusted on the basis of American selling prices. Foreign manufacturers, it is claimed, have been selling blown glassware in the United States as much as 30% lower than prices quoted by domestic producers. The brief called attention to the case of the new Waldorf-Astoria Hotel, New York, whose owners placed large orders for foreign glass at from 25 to 30% less than the lowest prices offered by American producers.

The Union points out that during the past year the glass blowers have been employed only about 30% of the time and that the average wage, largely on account of foreign competition, is less than $31.00 a week as compared with $37.00 in 1929 for those that worked, and in fact lower than at any period since 1922.

According to the brief, American labor cost of production of blown glassware (goblets, tumblers, water bottles, etc.) represents from 60 to 70% of the total cost of such ware. The brief shows that skilled workers in 1929 were paid $50.00 a week in the United States while the wage paid for similar work in Czechoslovakia was $14.80 and in Germany $22.00.

Purdue University Conference on Welding

The Engineering Extension Department of Purdue University announces its Seventh Annual Conference on Welding at Lafayette, Ind., on December 10-11, 1931. The meeting will consist of lectures, demonstrations, and exhibits. Two hundred and seventy-five representatives from the industries of Indiana and neighboring states were in attendance at the conference last year.

Gamma Rays Search Out Defects in Welds

Discussing Gamma Rays, *Research Narratives,* published by The Engineering Foundation, New York, states that gamma rays made from radium can be made to shine through steel objects 12 inches thick and reveal their internal defects. Welded parts can be inspected to be sure the welds are sound, and even to check the welding procedure before actual work is begun. It is surprising that these gamma rays, known about in general for nearly 30 years, should never have received the proper handling and adaptation necessary to make them serve this useful purpose.

Electrical Welding Patent Infringed

The United States Circuit Court of Appeals for the Sixth Circuit has held that patent No. 1,066,468 relating to the art of electric welding is valid and infringed. Claims of product patent No. 1,196,744 were found to be void. The Westinghouse Electric and Manufacturing Company was involved in the case.

New Industrial Advertising Agency

J. T. Chirurg and K. R. Sutherland have recently organized at Boston, Mass., The K. R. Sutherland Co. to specialize in industrial accounts. Both Mr. Chirurg and Mr. Sutherland received their theoretical training at The Massachusetts Institute of Technology and their practical training on the firing line with industrial concerns. This company offers to industrial advertisers the services of an agency in which the principals are thoroughly trained to understand the peculiar problems inherent to technical advertising.

Harry L. Erlicher Now G. E. Purchasing Agent

Harry L. Erlicher, who entered the employ of the General Electric Company as an office boy in the purchasing department, has been appointed purchasing agent, succeeding L. G. Banker who retired on October 1 after completing 43 years of continuous service with the company. In his new position Mr. Erlicher will direct purchases of materials aggregating more than $100,000,000 a year.

Short Course Ceramics

The biennial Ceramic Short Course at the University of Illinois will be given January 25 to February 5, 1932. There will be three divisions: (a) Structural Clay Products, (b) Bodies and Glazes, and (c) Vitreous Enamels.

While this course is designed primarily for those interested in pottery glazes, methods of forming, drying and burning clay, etc., those interested in glass who attend the structural clay products course will receive five lectures daily, covering such subjects as the properties of clays, mining, clay preparation, forming, drying and burning.

October and September Production Polished Plate Glass

From figures compiled by P. A. Hughes, secretary Plate Glass Manufacturers of America, the production of polished plate glass in the United States for the month of October, 1931, was 4,531,507 sq. ft., as compared with 4,610,930 sq. ft. produced in the preceding month, September, 1931.

Among the glassware firms and individuals cooperating in the 12th Exhibition of Contemporary American Industrial Art at the Metropolitan Museum of Art, New York, in October were the following: Frederick Carder, Steuben Division, Corning Glass Works; Fostoria Glass Company, and Samuel Hawkes. Products of the above mentioned concerns were shown.

Coming Meetings

The National Glass Distributors Association is holding its annual meeting, Pittsburgh, Dec. 1-3, 1931. Wm. Penn Hotel.

Glass and Pottery Show, Pittsburgh, 51st Annual Exhibit, January 11-21, Fort Pitt and William Penn Hotels.

Inquiries Received

For further information address THE GLASS INDUSTRY.

563. Wanted—Increasingly large quantities of crushed glass granules that will pass a 24 mesh screen and be retained on a 30 mesh screen. Must be of clear glass of high ultra-violet ray filtering quality and obtainable at low cost.

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C. For further information write the department.

Colombia—54303. Glass containers, cylindrical, for packing pomade, 3,000.

Peru—54466. Glass tumblers, cheap.

Panama—54431. Bottles, medicine, for drug stores and hospitals.

Mexico—54350. Glass perfume bottles, opaque cream jars, labels, etc.

Porto Rico—54636. Glass containers for pharmaceutics, jars for jams and jellies, and corks.

Panama—54592. Glass for neon signs.

Canada—54594. Glass and chinaware, hotel and restaurant.

Mexico—54832. Glass containers for brilliantine and porcelain containers for creams.

Canada—54700. Glass bottles, syphonic, large, for reservoirs for range oil burners.

Chile—54939. Glass, flat, common and plate.

Domestic—54939. Glassware (dishes).

Cuba—54945. Glassware, table.

Readers Wants and Offers

Address answers to all "keyed" ads c/o The GLASS INDUSTRY, 24 West 40th St., New York

SITUATION WANTED

By Glass Technologist and Engineer, as factory manager, now employed. Many years' experience on both plain and colored glass, tanks and pot furnaces. Would like to get in touch with some progressive company who want to do things. Address Box O-1, as noted above.

WILL PAY REASONABLE PRICE
for a copy of July, 1927, issue of
THE GLASS INDUSTRY
in good condition.
Address NX, c/o THE GLASS INDUSTRY.

Current Prices of Glass-Making Materials

November 22, 1931

Quotations furnished by various producers, manufacturers and dealers.

Acid		Carlots	Less Carlots
Citric (dom.)	lb.	..	.35
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.12½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.26½
Alcohol, denatured	gal.	..	..
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.15½
Ammonia water (NH_4OH) 26° drums	lb.	..	..
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	..	.09¾
Antimony sulphide (Sb_2S_3)	lb.	..	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.14 .04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05¼
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	..	.07¼
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.07125	.0625-.08125
Refined	lb.	.0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb.	..	.65-.90
Orange	lb.	..	.60-1.10
Yellow	lb.		1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	.23	.24
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	1.35-1.45
In 10 lb. tins	lb.	..	1.45
Copper oxide			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.17-.19
Black prepared	lb.	..	.22
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.09¼
Synthetic (Artificial)	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
*Feldspar—			
100 mesh	ton	11.50-17.50	12.00-18.00
80 mesh	ton	11.00-11.50	13.00
40 mesh	ton	10.75-11.00	12.00
20 mesh	ton	9.50- 9.75	10.00
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2 2½%)			
Bulk, carloads, f.o.b. mines	ton	30.00	..
In bags or barrels	ton	34.00	39.00
Imported	ton	30.00-31.00	33.00-37.00
Formaldehyde	lb.	..	.07
Graphite (C)	lb	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0425
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00

*Spot Shipments.

Kryolith (see Cryolite)		Carlots	Less Carlots
Lead cnromate ($PbCrO_4$)	lb.	..	30
Lead oxide (Pb_3O_4) (red lead)	lb.	.0645	.075
Litharge (PbO)	lb.	.0545	.065
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	6.50	6.50
Burnt (CaO) ground, in bulk	ton	6.00	..
Burnt, ground, in paper sacks	ton	8.00	8.00
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	..
Limestone ($CaCO_3$)		1.50-2.50	1.75-3.50
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb	.06	.07
light (in bbls.)	lb.	..	.22
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.10
Manganese 85% (MnO_2)	lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb	..	.35
Nickel monoxide (NiO), green— for nickel content	lb	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb	.09	.09¼
Ground	lb	.11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07¼
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.25
Potassium hydrate (KOH) (caustic potash)	lb.	.07¼	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.16	.17
Powdered blue	lb.	..	.17½-.18
Rochelle salts, bbls.	lb.	..	.16½-
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.80
Silver nitrate ($AgNO_3$)	(100 oz.) per oz.	..	.24¾
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.05	..
In barrels	Per 100 lb.	1.38	1.90-2.00
In bags	Per 100 lb.	1.17½	1.72½
Spot orders	.025 per 100 lbs. higher	..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.		..	..
96 per cent.	Per 100 lb.	1.67-177	1.72-1.82
Sodium selenite (Na_2SeO_3)	lb.	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04	.04½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.37½	.39
Tin oxide (SnO_2) in bbls.	lb.	.28	.29½
Uranium oxide (UO_2) (black, 96% U_3O_8)			
100 lb. lots. Black	lb.	..	2.75
Yellow	lb.	..	1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process. Bags	lb	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude. Gran (Milled .005-.02c higher)		03¼	04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to October 27, 1931.

	September 1930 Quantity	September 1930 Value	September 1931 Quantity	September 1931 Value	Nine Months Ending September 1930 Quantity	Nine Months Ending September 1930 Value	Nine Months Ending September 1931 Quantity	Nine Months Ending September 1931 Value
Glass and glass products (Total)	.....	$746,733	.....	$539,246	.....	$7,040,875	.....	$5,513,230
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,112	12,772	359	1,805	14,084	76,854	6,338	31,495
Plate glass, unsilvered, sq. ft.	213,141	75,440	215,553	61,849	2,592,996	800,955	2,937,728	892,548
Other window and plate glass lbs.	323,588	27,529	223,642	20,526	4,098,905	350,272	2,240,423	230,366
Glass containers (bottles, vials and jars)	.. ..	259,202	.....	186,034	.....	2,380,370	.....	1,675,992
Table glassware, plain	.. ..	90,033	.....	92,655	.....	888,091	.....	704,336
Table and other glassware, cut or engraved	.. ..	9,660	.....	6,250	.....	71,417	.....	64,291
Lamp chimneys and lantern globes lbs.	.....	12,294	.....	5,172	.....	176,935	.....	71,785
Globes and shades for lighting fixtures lbs.	.....	46,917	.....	35,573	.....	453,684	.....	319,344
Chemical glassware lbs.	24,731	21,438	12,625	12,242	188,503	174,815	114,201	112,161
Electrical glassware, except for lighting lbs.	98,181	9,724	27,502	1,863	3,016,110	201,983	1,119,340	73,001
Other glassware	.....	181,724	.....	115,277	.....	1,465,499	.....	1,337,911

IMPORTS

Corrected to October 27, 1931.

Glass and glass products	.....	$992,920	.....	$714,900	.....	$6,873,220	.....	$4,755,989
Cylinder, crown, and sheet—								
Plain dut. lb.	419,681	14,719	223,736	9,211	12,708,562	498,009	6,261,415	243,773
Bent, beveled, colored, etc. dut. lb.	268,715	25,596	99,988	19,249	.....	278,106	1,382,094	193,571
Plate glass dut. sq. ft.	540,296	97,395	389,876	64,822	4,253,816	910,936	3,805,185	932,875
Glass mirrors	86	208	357	649	377	703	1,407	3,407
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.	.. ..	4,360	.....	8,315	.....	13,754	.....	61,047
Laminated glass and manufactures, and plated glass	.. ..	3,694	.. ..	97	.. ..	10,624	.. ..	15,899
Bottles, vials, jars, and other containers	.. ..	91,634	.....	47,115	.. ..	913,669	.. ..	383,092
Scientific articles and utensils dut.	.. ..	33,051	.....	31,955	.. ..	410,085	.....	316,823
Tubes and rods dut.	.....	6,814	.....	10,365	.. ..	22,673	.....	101,890
Illuminating articles dut.	.. ..	47,033	.....	28,298	.. ..	456,686	.....	274,856
Blown glass articles—								
Bulbs for electric lamps, without filament dut.	.....	.....	714,844	5,939	.....	.....	9,805,854	91,632
Other blown glass articles dut.	.....	.....	.....	387,770	.....	.....	.....	1,372,073
Pressed glass articles	.....	28,890	.....	7,596	.....	157,950	.....	87,739
Other glassware	.....	96,412	.....	93,519	.....	833,376	.....	677,312

306437